ARCTIC DATA COMPILATION AND APPRAISAL – VOLUME 16
Queen Elizabeth Islands: Chemical Oceanography 1952 through 1985

by

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CANADIAN DATA REPORT OF HYDROGRAPHY AND OCEAN SCIENCES NO. 5

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Canadian Data Report Of Hydrography and Ocean Sciences

These reports provide a medium for the documentation and dissemination of data in a form directly useable by the scientific and engineering communities.

Generally, the reports will contain raw and/or analyzed data but will not contain interpretations of the data. Such compilations will commonly have been prepared in support of work related to the programs and interests of the Ocean Science and Surveys (OSS) sector of the Department of Fisheries and Oceans.

Data Reports are produced regionally but are numbered and indexed nationally. Requests for individual reports will be fulfilled by the issuing establishment listed on the front cover and title page. Out of stock reports will be supplied for a fee by commercial agents.

Regional and headquarters establishments of Ocean Science and Surveys ceased publication of their various report series as of December 1981. A complete listing of these publications and the last number issued under each title are published in the *Canadian Journal of Fisheries and Aquatic Sciences*, Volume 38: Index to Publications 1981. The current series began with Report Number 1 in January 1982.

Rapport statistique canadien sur l'hydrographie et les sciences océaniques

Ces rapports servent de véhicule pour la compilation et la diffusion des données sous une forme directement utilisable par les scientifiques et les techniciens.

En général, les rapports contiennent des données brutes ou analysées mais ne fournissent pas d'interprétations des données. Ces compilations sont préparées le plus souvent à l'appui de travaux reliés aux programmes et intérêts du service des Sciences et Levés océaniques (SLO) du ministère des Pêches et des Océans.

Les rapports statistiques sont produits à l'échelon régional mais sont numérotés et placés dans l'index à l'échelon national. Les demandes de rapports seront satisfaites par l'établissement auteur dont le nom figure sur la couverture et la page de titre. Les rapports épuisés seront fournis contre rétribution par des agents commerciaux.

Les établissements des Sciences et Levés océaniques dans les régions et à l'administration centrale ont cessé de publier leurs diverses séries de rapports depuis décembre 1981. Vous trouverez dans l'index des publications du volume 38 du *Journal canadien des sciences halieutiques et aquatiques*, la liste de ces publications ainsi que le dernier numéro paru dans chaque catégorie. La nouvelle série a commencé avec la publication du Rapport n° 1 en janvier 1982.

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PREFACE

These catalogues are produced by the Ocean Information Division at the Institute of Ocean Sciences and the Regulatory and Native Affairs Division of the Freshwater Institute. Joint government and industry contract projects have catalogued marine data sets their focus being primarily upon oceanography and fisheries. Data set quality appraisals are included to assist in establishing the usefulness of certain data for particular kinds of analyses and the confidence to be placed in interpretations. These appraisals will assist in setting priorities for incorporating the most useful data in the national Marine Environmental Data Service (MEDS) archives. Additional uses include research planning (especially for climatological studies), and the provision of the best available resume of marine data sources for environmental assessments.

The accelerating pace of Arctic offshore development activity has emphasized the need to review the sufficiency and suitability of available scientific information for design, regulatory and planning purposes. This review has been divided into three phases: (1) compilation and appraisal of all existing data sets; (2) analysis of the suitability of the historical data for contributing to questions of particular interest; and (3) analysis and interpretation of data and estimation of the scientific confidence in answering particular questions. This report on the chemical oceanographic data of the channels of the Queen Elizabeth Islands is a contribution to the first phase.

Brian Smiley and Larry de March
Scientific Editors
Arctic Data Compilation
and Appraisal Series

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ABSTRACT

D.J. Thomas, M. Yunker, P. Wainwright, and R.W. Macdonald. 1986. Arctic Data Compilation and Appraisal. Volume 16. Queen Elizabeth Islands: Chemical Oceanography, 1952 through 1985.

Can. Data Rep. Hydrogr. Ocean Sci. 5: (Volume 16) 125 pp.

This volume is one of a group of catalogues designed to compile and appraise marine data sets for the Canadian Arctic. For ease of reference, the group has been organized with its subject matter divided into three disciplines: physics, chemistry and biology. The Arctic has been arbitrarily divided into seven geographical areas to include, where possible, major oceanographic regions. The format has been structured to facilitate comparison between subjects and regions. With such a large undertaking it is not possible to provide all reports at once. Therefore catalogues which are presently available in the series are indicated on the inside back cover of each volume.

Data collection is a continuing process and further updates of the catalogues are planned. Readers are invited to submit corrections and additions by writing the issuing establishment. These corrections will be incorporated in on-line computerized data set listings; they will be continuously available upon request.

SOMMAIRE

D.J. Thomas, M. Yunker, P. Wainwright, and R.W. Macdonald. 1986. Arctic Data Compilation and Appraisal. Volume 16. Queen Elizabeth Islands: Chemical Oceanography, 1952 through 1985.

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Le présent volume fait partie d'un groupe de catalogues destines à compiler et à évaluer les séries de données marines sur l'Arctique canadien. Pour plus de simplicité, la question traitée est structurée en trois grandes disciplines: physique, chimie et biologie. L'Arctique a été divisé arbitrairement en sept régions géographiques qui englobent autant que possible les grandes régions océanographiques. Les catalogues sont presentés de façon à faciliter la comparaison entre les sujets et les régions. Le domaine est si vaste qu'il est impossible de fournir tous les catalogues d'un seul coup. Les catalogues actuellement disponibles sont indiqués à la fin de chaque volume à l'endos de la couverture.

La collecte de données est un processus permanent et il est prévu de mettre à jour les catalogues par la suite. Les lecteurs sont invités à soumettre par écrit les corrections et additions à l'organisme responsable. Corrections seront traitées en direct sur ordinateur et incorporées aux listes; celles-ci pourront être obtenues sur demande.

ACKNOWLEDGEMENTS

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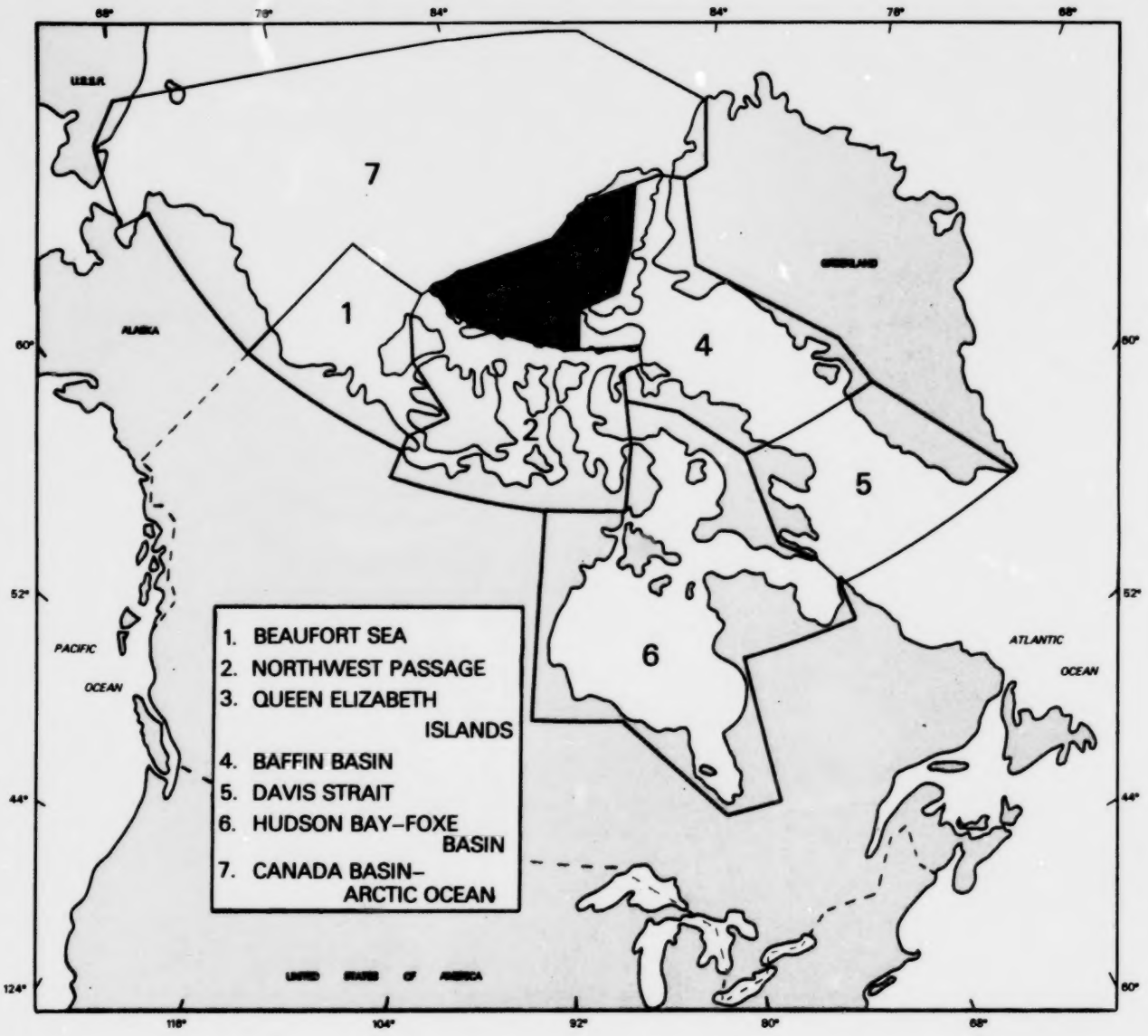

The area (3) covered by this volume is shaded on the map above.

ARCTIC DATA COMPILATION AND APPRAISAL

VOLUME 16

QUEEN ELIZABETH ISLANDS: CHEMICAL OCEANOGRAPHY

Volume 16: Queen Elizabeth Islands: Chemical Oceanography

VOLUME ABSTRACT

This inventory contains a catalogue of chemical oceanographic data sets from the Queen Elizabeth Islands. The inventory includes commonly- measured substances such as dissolved oxygen, major and minor elemental components, nutrients and less frequently measured substances such as trace elements, hydrocarbons and chlorinated hydrocarbons. Suspended particulate matter (although not a truly chemical quantity) is also included. Data sets are included for sea ice, sea water, sediments and biota. Times and locations of measurements are listed and displayed graphically on a yearly and cumulative bi-monthly basis. A geographical index and alphabetical references (by data set number) are also included.

Key Words: Queen Elizabeth Islands, chemical oceanography, data sets, inventory, dissolved oxygen, nutrients, heavy metals, hydrocarbons, chlorinated hydrocarbons, suspended particulate material, sea ice, sediments, biota.

1. INTRODUCTION

This inventory comprises 32 data sets of chemical oceanographic data collected in the marine areas of the Queen Elizabeth Islands during the period 1952 - 1982. Most of the data reported in this inventory can be classified as baseline data and are statements of observed distributional patterns of the various chemical species. Before 1970, water column measurements such as dissolved oxygen and nutrients were virtually the only data obtained. After 1970, a wider range of data were obtained in response to a need for environmental data by government and industry interested in exploiting regional resources but usually on a very narrow geographical basis only. The frequency of occurrence of selected chemical quantities in the 32 data sets is summarized for each sampling medium (sea water, ice, sediment and biota) in Table 1.1.

There is no evidence in the published literature for any systematic interpretation of the chemical oceanographic data to explain the observed distribution patterns in terms of fundamental oceanographic processes. The main reason for this is the limited data available.

TABLE 1.1

FREQUENCY OF OCCURRENCE (NUMBER OF DATA SETS) OF SELECTED CHEMICAL QUANTITIES FOR EACH SAMPLING MEDIUM

	Sea Water	Ice Cores	Sediments	Biota
Dissolved Oxygen	26	-	-	-
pH	2	-	-	-
Nutrients				
Nitrate	11	2	-	-
Phosphate	10	1	-	-
Silicate	11	-	1	-
Ammonia	1	-	-	-
Ch. a	4	2	-	-
ATP	1	-	-	-
Ch. b	-	1	-	-
Ch. c	-	1	-	-
Helium	1	-	-	-
Phaeopigments	0	2	-	-
Isotopes	1	-	-	-
Alk_t	1	-	-	-
Carbon	1	-	1	-
Hydrocarbons				
Methane	1	-	-	-
Oil	1	-	1	-
Tar	1	-	-	-
Metals				
Vanadium	-	-	1	-
Chromium	-	-	1	-
Manganese	1	-	1	-
Iron	2	-	2	1
Cobalt	-	-	1	-
Nickel	1	-	-	-
Copper	1	-	2	1
Zinc	1	-	3	1
Arsenic	1	-	-	-
Cadmium	1	-	3	1
Mercury	-	-	1	-
Lead	1	-	3	1
Magnesium	-	-	1	-
Aluminum	-	-	1	-
Titanium	-	-	1	-
Calcium	-	-	1	-
Lithium	-	-	1	-
Neon	1	-	-	-
Nitrogen	1	-	-	-
Tritium	2	-	-	-
Deuterium	1	-	-	-

The objective of this inventory was to compile all available descriptions of Queen Elizabeth Islands chemical oceanographic data sets into a single catalogue and to appraise the quality of the data so as to obtain, for the first time, a broader perspective on what is currently known about the chemical oceanography of the marine areas of the Queen Elizabeth Islands.

The inventory is ongoing. As new data and previously inaccessible data become available, they will be catalogued in a computerized geographical information system maintained at the Institute of Ocean Sciences, Sidney, B.C. Information about new data sets, older data sets which do not appear in this inventory or errors in this inventory, should be submitted in writing to the Institute of Ocean Sciences.

The following sections contain the rationale for organizing the data as it appears in the tables. Wherever possible, formats were adopted that were consistent with those used in the companion inventory for the physical oceanography of the Queen Elizabeth Islands (Fissel et al. 1983).

2. STUDY AREA

The study area, as shown in Figure 2.1, consists of the waterways of the Queen Elizabeth Islands of the Northwest Territories extending as far east as Ellesmere and Devon Islands. It includes the central area of the Sverdrup Basin (Hazen Strait, Desbarats Strait, MacLean Strait, Belcher Channel, Norwegian Bay) along with the connecting channels to Parry Channel to the south (Crozier and Pullen Straits, Kellett Strait, Crozier Channel, Fitzwilliam Strait, Byam and Austin Channels, McDougall Sound, Wellington Channel to Fram and Jones Sound in the southeast (Cardigan Strait and Hell Gate), and to the Arctic Ocean in the north and west (Ballantyne Strait, Wilkins Strait, Prince Gustaf Adolf Sea, Peary Channel, and Sverdrup Channel). In addition, the study area encompasses the water channels of the west coast of Ellesmere Island, including Greely Fjord, Nansen and Eureka Sounds and adjoining fjords.

Water depths in the area show a general tendency to decrease from north to south. The adjoining continental shelf to the north of the Queen Elizabeth Islands has a typical depth of 500 m. A similar depth range is found in the Prince Gustaf Adolf Sea, Peary and Sverdrup Channels and Nansen Sound. However, some deeper depressions occur, notably to 920 m in the Nansen Sound Greely Fjord system, to 700 m in Peary Channel and to 600 m in Prince Gustaf Adolf Sea. In the central portion of the study area, the relatively deep waters of 400 m or more are separated into distinct basins by northward protruding zones of shallow water: such shallow zones with depths less than 200 m extend northward across Desbarats Strait to Loughheed Island and northward across Belcher Channel and Hendriksen Strait to Amund Ringnes Island. The presence of a sill between Nansen and Eureka Sounds restricts horizontal water movements to depths above 120 m.

The depths of passage at the southern limit of the study area are limited to 100 m in Hell Gate, 170 m in Cardigan Strait, 160 m in Penny Strait, 120 m in Austin Strait, 100 m in Byam Strait and 250 m in Fitzwilliam Strait.

An important factor in determining the extent of oceanographic data is the sea-ice coverage. Where present in sufficient quantity and thickness, sea-ice can provide a stable platform for the collection of oceanographic data. However, at times when sea-ice is breaking up or forming, oceanographic data collection is severely hindered.

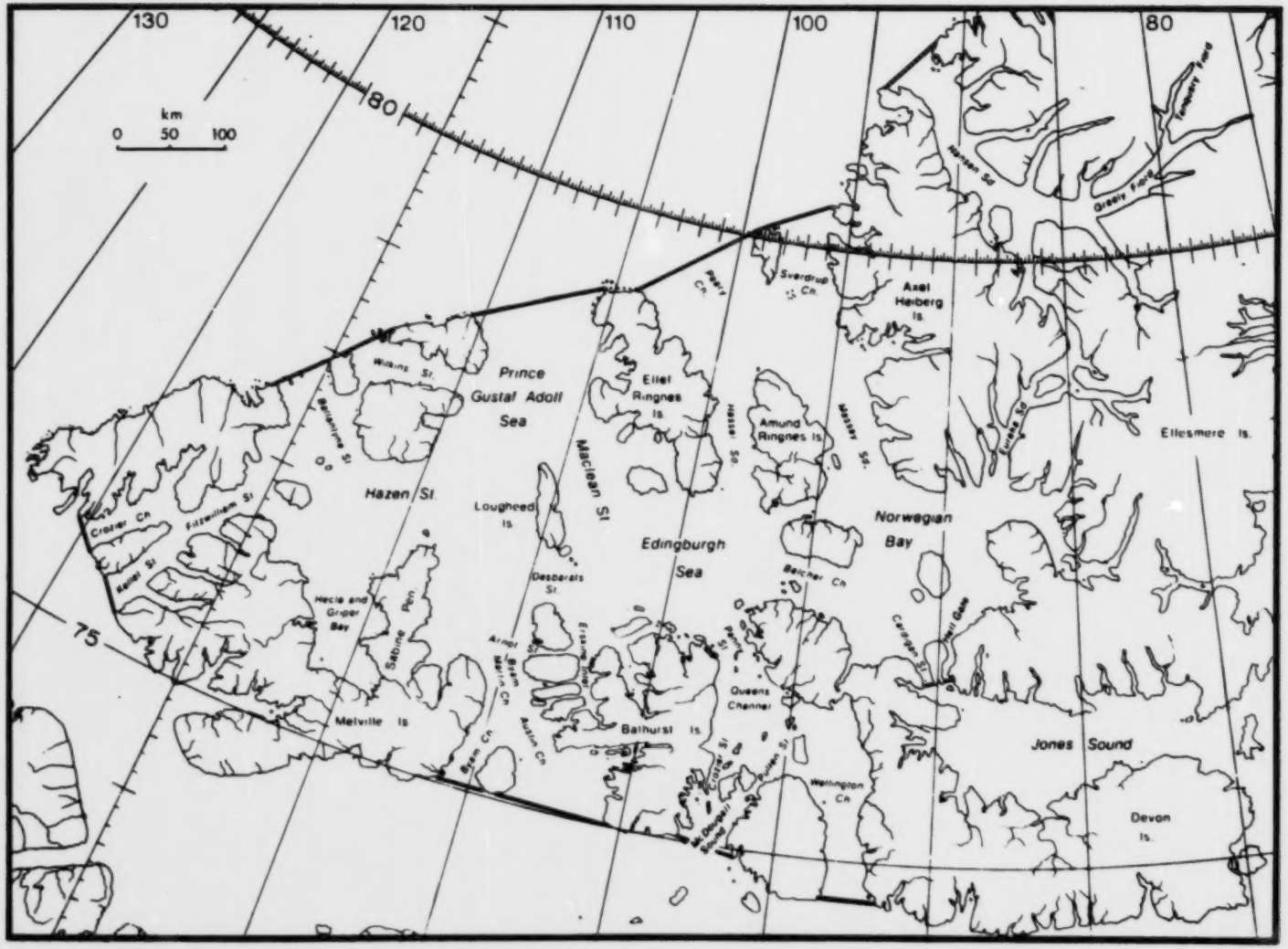

Figure 2.1 Queen Elizabeth Islands data compilation study area including place names.

During the winter months, ice conditions are severe in the study area. Typically, the area is covered by a combination of first-year and multi-year sea-ice floes. The multi-year ice floes often originate in the Arctic Ocean and are carried south into the region by the winds and currents. In many of the channels, the horizontal displacements of the ice-cover are limited to 1.5 m or less during winter. Polynyas (areas of open water or thin ice) have been known to occur in some of the southern channels, particularly in Hell Gate and northern portions of Wellington Channel. In most of the study area, the winter sea-ice provides a stable platform, useable for such activities as drilling for oil and gas, and collecting oceanographic data.

In summer, the ice coverage is less extensive, with large variations occurring from one year to another. Normally, the eastern portion of the central area (MacLean Strait and Norwegian Bay into Eureka Sound), exhibits considerable amounts of clearing, whereas further to the west, the region remains under seven-tenths or more of ice cover. The southern channels in the east clear out, often completely, whereas the more westerly channels can clear partially, but seldom completely.

3. HISTORICAL DATA

The quantity of data obtained are distributed irregularly over the period 1952 - 1985 with the greatest number of data sets being collected from 1960 -1964 and from 1971 - 1977 (Figure 3.1).

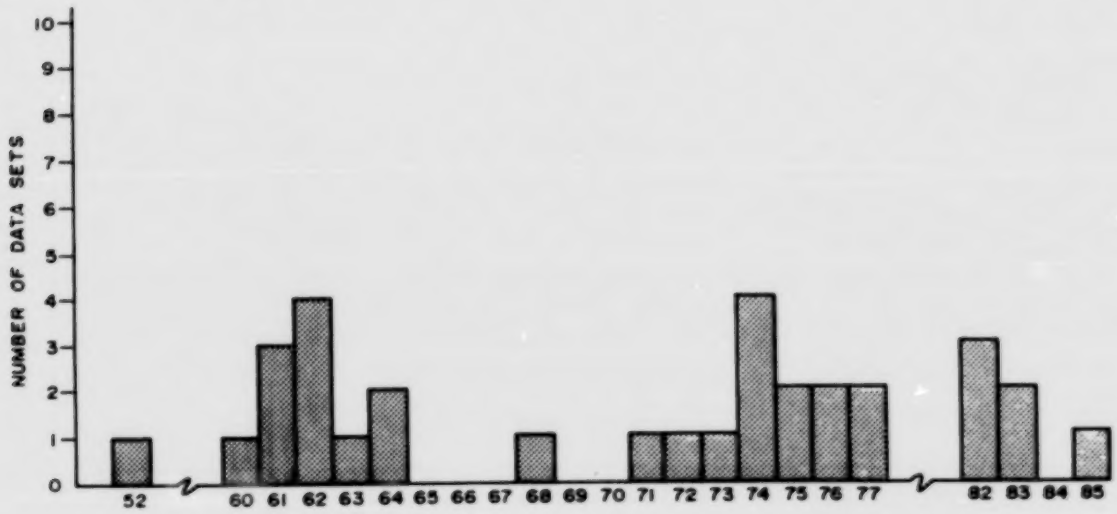

Figure 3.1 Yearly distribution of chemical oceanographic data sets for the Queen Elizabeth Islands.

The first data of a chemical nature obtained in the Queen Elizabeth Islands area were bottle cast measurements of dissolved oxygen collected by government agencies in the 1950s and 1960s. In the 1970s, both government and industry conducted sampling excursions to the Queen Elizabeth Islands area in conjunction with the increasing search for exploitable minerals and oil and gas in the region. This resulted in the collection of data beyond measurements of dissolved oxygen in the water column to dissolved nutrients and chlorophyll a and sediment metals. Nevertheless, the size of the data base of chemical oceanographic measurements remains limited due to the logistical impediments and high costs associated with the collection of data in this remote arctic region with a very limited navigational season.

Several reports that could not be obtained during this study are likely or known to contain chemical data. These reports were produced largely for Panarctic Oils Ltd. and the Arctic Gas Corsortium. During 1986, most of the holdings of the Panarctic Library were transferred to the Arctic Institute of North America (AINA) Library at the University of Calgary. The cataloguing process is on-going. It is still not clear whether the reports in question are in fact in storage at AINA or at the difficult to access Panarctic Library.

4. CHEMICAL DATA PRESENTATION

4.1 Types of Data

All chemical data have been grouped according to the environmental medium or compartment in which they are found, as follows:

Medium	Constituents Included
Sea Ice	- dissolved or occluded
Water Column (Sea Water)	- dissolved constituents - particulate constituents
Sediments	- surficial sediments - sediment cores (interval sampling) - interstitial pore waters
Biota (flora and fauna)	- seawater dwelling organisms - bottom sediment dwelling organisms - marine mammals

The inventory describes all available data of a "chemical nature". This includes commonly-measured substances such as dissolved oxygen, major and minor elemental components, nutrients and less frequently measured substances such as trace elements, hydrocarbons and chlorinated hydrocarbons. Turbidity and suspended particulate material are not truly chemical quantities in the classical sense, but are included in the inventory because they are important factors in the interpretation of chemical data and because they are more logically included with the chemical inventory rather than the physical or biological inventories.

The largest amount and most diverse data are found for water column constituents. Field-based analyses of samples at the time of collection have been rare because most chemical analyses require specialized or sophisticated equipment. Water samples have been frequently processed in the field to the stage where sample preservation is convenient and then returned to the laboratory for analysis. Samples for dissolved oxygen and pH analysis, on the other hand, have been routinely analysed in the field shortly after collection. Other determinations which can and have been made in the field include methane and the reactive nutrients although the latter have also been preserved and returned to the laboratory. Measurements have been made rarely in situ, and then only for dissolved oxygen and pH.

The other types of samples: biota, sediments and sea ice, have been obtained in decreasing quantities respectively and all have been analysed exclusively in the laboratory after preservation for some extended period of time. A summary of the chemical data types included in the inventory is shown in Table 4.1.

4.2 Concentration Units

Several different concentration units have been used over the years to report the chemical results for Queen Elizabeth Islands data. In order to eliminate confusion and provide for ease of data comparison between data sets, the International System of Units (Systeme International, SI) has been used wherever possible. Exceptions in the use of SI are classes of compounds comprising assemblages of different molecules such as polycyclic aromatic hydrocarbons and polychlorinated biphenyls. The trend toward worldwide use of SI units as a standard has been established by resolutions of the General Conference of Weights and Measures. In addition, the International Union of Pure and Applied Chemistry (IUPAC) endorses the exclusive use of SI units for chemical quantities. An important

TABLE 4.1

A SUMMARY OF CHEMICAL DATA TYPES INCLUDED IN THE DATA INVENTORY

Chemical Constituent	Water	Ice Cores	Sediment	Biota
adenosine triphosphate (ATP)	x			
alkalinity (total)	x			
aluminum	x			
ammonia	x			
arsenic	x			
cadmium	x		x	x
calcium			x	
carbon	x			
carbonate	x			
carbon dioxide			x	
total organic carbon			x	
chlorophyll a	x	x		
chlorophyll b		x		
chlorophyll c		x		
chromium			x	
cobalt			x	
copper	x		x	x
deuterium	x			
helium				
dissolved	x			
3He/4He isotopic ratio	x			
iron	x		x	x
lead	x		x	x
lithium			x	
magnesium			x	
manganese	x		x	
mercury				
elemental			x	
methane	x			
neon	x			
nickel	x		x	
nitrogen	x			
nitrate	x	x		
nitrite	x	x		
oil and grease	x		x	
oxygen				
dissolved	x			
$^{18}O/^{16}O$ isotopic ratio	x			

TABLE 4.1 (continued)

A SUMMARY OF CHEMICAL DATA TYPES INCLUDED IN THE DATA INVENTORY

Chemical Constituent	Water	Ice Cores	Sediment	Biota
pH	x			
phaeopigments		x		
phosphorus				
phosphate	x	x		
silicate	x			
silicon	x	x		
titanium		x		
tritium	x			
vanadium				x
zinc	x		x	x

advantage of using SI units for chemical oceanographic and geochemical data is the ease by which mass fluxes and chemical budgets can be calculated and compared for various elements and chemical compounds.

Factors used to convert units found in original reports to SI units are listed in Table 4.2.

5. DATA INVENTORY ORGANIZATION

5.1 Outline

The data are organized into a chronological series of data sets beginning with the year 1952. No chemical data collected before 1952 could be found. Each data set comprises sampling or chemical measurements taken during a single cruise, or during a sampling excursion usually by a single agency. It is assumed, then, that data within a given data set have been collected uniformly and should be internally consistent insofar as sampling methodology is concerned.

Each data set has been assigned an identification number of the form yy-nnnn, where yy = last 2 digits of the year in which data were collected and nnnn = order of identification for that particular data set for that year. The data set number is a unique identifier which applies throughout this series of inventories; for example, any data set identified as 72-0011 is the same no matter where the reference to it is made.

In certain cases, data may have been collected over a period of months or years by a common study team with minor or major differences occurring in the types of data collected at each sampling period. When this occurred, letters were used as a suffix to the data set number to distinguish the various samplecollections. For example, data set 74-0014 is divided into three parts in the inventory - 74-00144A, 74-0014B and 74-0014C. (Note: only 74-0014A is referred to in this inventory.) While there is insufficient reason to regard the three as separate data sets because all samples were collected during a single cruise, the subdivision is made to emphasize that different parameters were sampled by three separate groups of scientists during the sampling period. Gaps may appear in the sequence of data set numbers in this inventory for a particular year, because each data set will not appear in every discipline and geographical area.

This inventory comprises three main tables followed by supporting figures and supporting tables. Table 1 is a chronological list of data sets by data set number (see

TABLE 4.2

CONVERSION FACTORS AS NUMERICAL MULTIPLES OF SI UNITS

CHEMICAL QUANTITY	TO CONVERT FROM*	TO	MULTIPLY BY
	litres	m^3	1,000
	mg L^{-1}	g m^{-3}	1
ammonia	mg L^{-1} (NH_3)	mmol m^{-3}	58.82
	µg at L^{-1} (NH_3)	mmol m^{-3}	1
arsenic	µg L^{-1}	µmol m^{-3}	13.35
	µg g^{-1}	µmol kg^{-1}	13.35
cadmium	µg L^{-1}	µmol m^{-3}	8.90
	µg g^{-1}	µmol kg^{-1}	8.90
calcium	µg L^{-1}	µmol m^{-3}	24.95
carbon	µg g^{-1}	µmol kg^{-1}	83.26
carbon dioxide	% (wt/wt)	mol kg^{-1}	0.227
chromium	µg L^{-1}	µmol m^{-3}	19.23
	µg g^{-1}	µmol kg^{-1}	19.23
cobalt	µg L^{-1}	µmol m^{-3}	16.97
	µg g^{-1}	µmol kg^{-1}	16.97
copper	µg L^{-1}	µmol m^{-3}	15.74
	µg g^{-1}	µmol kg^{-1}	15.74
iron	µg L^{-1}	µmol m^{-3}	17.91
	µg g^{-1}	mmol kg^{-1}	0.0179
lead	µg L^{-1}	µmol m^{-3}	4.83
	µg g^{-1}	µmol kg^{-1}	4.83
lithium	µg L^{-1}	µmol m^{-3}	144.09
magnesium	% Mg (w/w)	mol kg^{-1}	0.411
manganese	µg L^{-1}	µmol m^{-3}	18.20
	% Mn (w/w)	mol kg^{-1}	0.182
mercury	ng L^{-1}	nmol m^{-3}	4.99
	ng g^{-1}	ng kg^{-1}	4.99
methane	nL (STP) L^{-1}	nmol m^{-3}	44.64

TABLE 4.2 (continued)

CONVERSION FACTORS AS NUMERICAL MULTIPLES OF SI UNITS

CHEMICAL QUANTITY	TO CONVERT FROM*	TO	MULTIPLY BY
	litres	m^3	1,000
	mg L^{-1}	g m^{-3}	1
nickel	µg L^{-1}	µmol m^{-3}	17.03
	µg g^{-1}	µmol kg^{-1}	17.03
nitrogen	mg L^{-1}	mmol m^{-3}	71.43
	mg kg^{-1}	mmol kg^{-1}	0.0714
nitrate	mg L^{-1} (NO_3)	mmol m^{-3} (NO_3)	16.13
	µg at L^{-1} (NO_3-N)	mmol m^{-3} (NO_3)	1
nitrite	mg L^{-1} (NO_2)	mmol m^{-3} (NO_2)	20.83
	µg at L^{-1} (NO_2-N)	mmol m^{-3} (NO_2)	1
oxygen	mg L^{-1} (O_2)	mol m^{-3} (O_2)	0.0313
	mL L^{-1} (O_2)	mol m^{-3} (O_2)	0.0446
phosphate	mg L^{-1} (PO_4)	mmol m^{-3} (PO_4)	32.29
	µg at L^{-1} (PO_4-P)	mmol m^{-3} (PO_4)	1
phosphorous	µg L^{-1}	mmol m^{-3}	0.0324
silicon	mg L^{-1} (Si)	mmol m^{-3} (Si)	35.60
	mg L^{-1} (SiO_3)	mmol m^{-3} (SiO_3)	16.64
	µg at L^{-1} (SiO_3-Si)	mmol m^{-3} (SiO_3-Si)	1
titanium	g L^{-1}	mol m^{-3}	20.88
vanadium	µg g^{-1}	µmol kg^{-1}	19.63

* **Note:**

In Table 2 conversions for dissolved constituents have been made assuming that the density of sea water is 1.00 i.e., that 1 µg L^{-1} is equivalent to 1 µg kg^{-1}.

above). Table 2 is a summary of specific details for actual chemistry data. Table 3 is a listing of times and locations of individual measurements. Where station co-ordinates were not specified in reports, approximate station positions were obtained by measuring plotted station locations on figures located in those reports. Measurement locations are plotted on one of two maps in Section 11. Both are in Lambert Conformal Conic projection. The map encompassing the study area is drawn to a scale of 1:4 750 000 (Standard parallels 76° and 80° N). The second map (Nansen - Eureka Sound Area) is drawn to a scale of 1:2 000 000 (Standard parallels 78° and 82 N); it yields better resolution of data sets containing closely spaced stations. In all cases, the coastlines have been smoothed and small islands removed to avoide clutter. To maintain uniformity and facilitate comparison, maps for all volumes in the Arctic data compilations have been drawn from common stock.

A listing of the geographical occurrence of data sets is given in the geographic index (Section 12.1). Section 12.2 is an index of references ordered by data set number. The first (primary) reference shown for each data set is the original data report or similar document. The secondary references that follow are other reports or refereed papers based on the primary reference. The listing of secondary references should not be considered an exhaustive literature search. Only those secondary references are included as were found while searching for original data set documents.

5.2 Sample Use of the Inventory

Example 1	Searching for specific-parameter data: e.g., Copper in sea water
Step 1.	Consult Table 1 and scan column labelled "Chemical quantities measured or sampled". Note data sets listing Copper (in bold print) as a measured parameter
Step 2.	Consult data set numbers noted in Step 1, Table 2, to obtain specific details of sample history and reported concentrations.
Step 3.	Refer to Table 3 for station positions, depths sampled, etc. If areal coverage of stations is of interest, go to Section 6 and consult maps for the data set(s) of interest. Maps are ordered chronologically.
Step 4.	Consult the reference list for reports or publications upon which the data set is based.

Example 2.	Searching for data from a specific geographic area: e.g., Copper in Smith Sound sea water
Step 1.	Consult Geographical Index or scan through dataset maps. Note data set numbers
Step 2.	Consult Table 1 for data sets reporting copper in sea water.
Steps 3 and 4.	As in Example 1.

When additional details concerning data are required, the original data sets must be consulted. Access to most documents may be obtained through Ocean Information Division at the Institute of Ocean Sciences, Sidney, British Columbia.

6. DATA RATING SYSTEM

6.1 Data Quality Criteria

The reported chemical data for the Queen Elizabeth Islands have been appraised using a rating system based on five data quality parameters related to methodology:

(A) sample collection;
(B) sample storage/preservation;
(C) sample analysis;
(D) analytical precision; and
(E) analytical accuracy.

These five parameters satisfy a fundamental requirement that the rating criteria allow an appraisal of any chemical measurement at any point in the history of a sample from collection to final analysis. In this way, the five parameters shown above represent a measure of the ultimate believability of results.

A quiet revolution has been taking place in recent years in the approach analytical chemists have for quality control and the establishment of well-defined performance criteria for analytical procedures. The most significant step was the general recognition that analytical quality control has been almost universally inadequate in the areas of environmental chemistry. The problem is resistance to

change; routine analysis and reporting procedures that have been in use for many years will not change overnight. The new concepts as articulated by Taylor (1983), Kirchmer (1983), Long and Winefordner (1983), Glaser et al. (1981) and Cheeseman and Wilson (1978) will eventually be practised and improved by analytical chemists. This evolutionary process will lead to results for environmental chemical samples far superior to those summarized in this inventory.

A general caution is appropriate at this time. A great deal of chemical data has been collected over the years by biologists. The objective in sampling has often been merely "to get a rough idea of metal contents or hydrocarbon contents, etc." rather than produce state-of-the-art results. There is an insidious danger in this approach to chemical oceanography and science in general; namely, that it encourages a lower level of care in all aspects of the methodology chain that, when added together, leads to far greater errors than originally intended or considered to be within acceptable limits. For this reason, all sampling teams should always strive for the best results within their capability for a given stated objective rather than those somewhat below.

Some general concepts and comments related to the five data quality criteria introduced earlier are discussed below, in terms of their use in the data evaluation.

A. Sample Collection

Sampling has traditionally received little attention and has been the weakest link in marine chemical measurements. The method of sampling is crucial, especially for heavy metals or trace hydrocarbons where baseline values are often at or near the detection limit of many analytical techniques. Very specific steps involving sample preparation and collection methodology must be followed with fanatical attention to detail so as to limit the effects of negative and positive contamination. These details are an integral part of the final reported number and must be specified with the results.

B. Sample Storage and Preservation

Once the sample is collected, it must be preserved in such a way that it remains representative of the water body, ice core, sediment, plant or animal from which it was collected or sampled. Storage containers are very important. When

storing samples for the determination of heavy metals in sea water, for example, a severe hot acid pretreatment of plastic or Teflon storage bottles must be achieved. Bottles used for storing hydrocarbon samples must be cleaned with solvent and baked to rid the containers of contaminating substances. Procedures specifically applicable to samples of other chemical substances are often necessary. Certain types of samples (e.g., nutrients, chlorophyll a, etc.) which are sensitive to change through biological activity, must be analysed or preserved immediately after collection before such activity begins to alter the sample irreversibly. Failure to do so will result in samples becoming unrepresentative of the original water mass. Acid is frequently used as a preservative for seawater samples for heavy metal analysis. Because the concentration of heavy metals is exceedingly low in sea water, only acids with the highest level of purity can be used, lest the acid addition introduce more analyte into the samples than that occurring naturally. Consequently, the purity of all preservatives must be carefully tested before use and must be specified in collection details. Length of time between collection and preservation should be reported exactly.

C. Analysis

Assessing the comparability of analytical results depends on a detailed description of the chemical protocol used. The protocol is a set of definitive directions that must be followed, without exception, if the analytical results are to be accepted for a given purpose. Protocol fits into the hierarchy of methodology as outlined by Taylor (1983) in the sequence **technique → method → procedure → protocol.**

Simple statements found in many reports that "sterile procedures were used" and "standard methods were used" do not provide enough information to form an opinion about the reliability of the technique employed or the validity of results obtained. This follows from the fact that most chemical laboratories dealing with the analysis of marine samples recognize that most procedures are not routine and that operational changes are often made. Thus, the instrumentation and analytical conditions employed; the quality and age of reagent chemicals; the values of reagent and procedural blanks; and the finesse of the analyst with the technique will be critical to the eventual outcome of the analysis. All these details must be specified. Also, quantitative proof that the analytical measurement is in control must be provided. Otherwise, the situation articulated by Eisenhart (quoted in Taylor, 1983)

will probably be all too true: "Until a measurement operation .... has attained a state of statistical control, it cannot be regarded in any logical sense as measuring anything at all".

C.1 Detection Limits and Blanks

Important performance criteria of an analytical method are detection limit and blanks. Many definitions for the term "detection limit" can be found in the literature. A consensus appears near. In qualitative terms the limit of detection is the lowest concentration of an analyte that can be reliably distinguished from an analytical blank (Long and Winefordner, 1983). Over the years, the calculated limit of detection for an element has varied as much as an order of magnitude through the use of different statistical approaches and different interpretations of what detection limit really is. This has important implications for the chemical oceanographic data for the Queen Elizabeth Islands region because many data sets contain detection limit values or values reported simply as "less than detection limit" and the detection limit is unspecified. No descriptions in sufficient detail (in most cases zero detail) are provided in any of the data sets so that data at the lower end of the reported ranges cannot be used with any degree of certainty.

Blanks are another performance criterion for an analytical process. Highly variable blanks lead to very poor estimates for the detection limit. All data sets in this inventory are inadequate in describing analytical blank procedures or values for the blanks. The combination of no information for the detection limit and blanks together with many data sets reporting variable detection limits leads to a situation where the data are uninterpretable. The data will probably remain so because there is no known algorithm which can transform incoherent data into coherent data. In addition, the low level of importance placed upon the concepts of detection limit and analytical blank control as recently as 1975 suggests that the chances are small that these performance criteria would have been determined in a satisfactory manner to have any positive impact on the results reported in this inventory.

D. Precision

Precision is a measure of random error. It is essential for defining significant intra-data differences and is usually expressed as the standard deviation of n

analytical measurements. It is possible for an analytical result to be very precise but inaccurate. Precision should be determined for each procedure, type of sample and analyst. It is very important that the estimation of precision is made on "real" samples and not on reference materials. A description of how precision was measured must be provided. The value given for this parameter with a group of data must truly apply to the specific analysis used to produce those data and not simply be a statement of that which has been achieved or that which can be achieved or expected by others for the same or a similar analytical technique. Precision may be estimated by numerous replicated determinations on a sample. This, however, probably leads to a biased estimate because the analyst is apt to take greater care with samples known to be used to measure variance. A better estimate can be made by blindfold determination of several replicated samples (covering the range of concentration expected for the samples) run randomly throughout the period of analysis.

E. Accuracy

Accuracy is a measure of systematic error. As pointed out by Kirchmer (1983), there is a problem in defining accuracy because of the discrepancy between the accuracy of individual analytical measurements and the accuracy of average (long-run) values obtained from a number of replicate measurements (n must be specified). Common practice has been to define accuracy as the deviation of the mean of n measurements from the "true" value; this is the definition used here. Another school of thought applies the term "bias" (equivalent to "systematic error") to the definition above and defines accuracy as the combined random and systematic errors of results. Systematic errors can arise from a variety of sources including:

- unrepresentative sampling;
- instability of samples between sampling and analysis;
- interference effects;
- biased calibration;
- a biased blank correction; and
- inability to determine all forms of the determinand.

It is clear that an accurate result can only occur after each of the above factors is defined quantitatively and precisely.

Accuracy can be estimated by comparing analytical results with the certified values for a reference material. Unfortunately, certified reference materials are available for only a limited number of elements or compounds in the various sample matrices or environmental phases. In practice, this means that the matrix of the reference material and that of the sample will rarely, if ever, be chemically equivalent. Consequently, when an analyst uses a reference material to validate an analytical procedure, the user of the data must judge whether the two matrices (sample and reference material) are sufficiently similar to warrant the use of the results for the reference material as evidence for the validity of the analytical results obtained for actual samples. A simple example illustrates this point: In judging the quality of an apple, only another apple which has been judged and certified to be of specified quality can be used as a reference. An orange, no matter how good, will not do. The apple may, in fact, be of high quality but this cannot be established on the strength of information obtained using an inappropriate reference material (the orange). In the same way, results for heavy metals in seal livers, for example, cannot be validated using National Bureau of Standards Reference Material 1571 (Orchard Leaves). At the very least, the lipid and oil content of the liver tissue would lead to chemical interferences far greater than those likely to occur with orchard leaves. The degree of interference will be specific to the analytical method; therefore, when assessing the quality of a data set, the experience of the scientist is very important for establishing criteria for accepting/rejecting reference materials in a given situation according to the specific details of each analysis.

When satisfactory reference materials are not available, accuracy of a method is sometimes estimated by measuring the ability of the method to recover a standard spike added to a portion of the sample or added to a material having a matrix similar to that of the sample. This method may fail to provide a reliable estimate of analytical accuracy because the added standard may not have a chemical reactivity which is equivalent to the component in the sample; it may, therefore, respond differently to the chemical steps involved in the determination. While this method of additions cannot prove that an analytical procedure is accurate, it can identify methods that are inherently imprecise by demonstrating poor and highly variable recoveries. When certified reference materials or standards are used, standardization should be blindfold and occur at random with replication. This avoids biased results caused by analysts who pay special attention to standardization samples and who know or are likely to guess the established reference material

composition. In addition, more than one reference material should be used to validate a given method whenever possible. This may identify matrix interferences that go unnoticed using a single matrix. When systematic errors are found (under- or over-recovery of the determinand), the results should be reported without correction for recovery data because the application of a correction factor may do little beyond replacing one wrong estimate with another.

Alternatives are available for demonstrating analytical accuracy. Agreement of results determined using different analytical methods employed by different laboratories during intercalibration exercises is one way of increasing confidence in the results. Although reference materials and intercalibrated results may generate confidence in an analytical result, they still can not prove whether the value obtained is an accurate representation of the true value in the environment. Satisfactory agreement among triplicate samples, consistently low blanks and results that make sense (and are consistent with other supporting measurements) will increase confidence.

It is important to distinguish between reference materials and primary standards. The chemical composition of a reference material is empirically derived from the pooled analytical results of several laboratories using different assay methods and instruments. Values for reference materials are commonly described as certified values, recommended values or average compositional values. By contrast, primary standard values are "true" values and are independent of the method of analysis. They are inherently more reliable than the values "recommended" for reference materials. A more detailed discussion of "standard" samples can be found in the review by Abbey (1980).

6.2 Definition of the Rating System

All data have been rated by a 5-level rating system, defined as follows.

Rating Score	Data Quality
0	data are found (or judged) to be wrong or unrepresentative
	example: seawater samples collected in metal Nansen bottles with metal content as the intended analysis
1	data are suspect because of ill-defined doubts

example: magnitude of results falls outside previous scientific experience (see Preface notes to Tables 1 and 2 for further details).

2 insufficient information to assess data; data were not investigated (where data no longer exist, an explanation is entered in remarks column).

3 data are internally consistent; patterns or trends within data are probably real but comparison with other data sets may be a problem (because of incomplete or improper standardization);

4 data are internally consistent and are sufficiently standardized or tied to a reference that comparison with other data at this rating score should be possible. (Data may not be accurate in an absolute sense because all data may be defined relative to a reference material having a different matrix).

This rating system can be criticized for not being hierarchical because the 2 rating score is misplaced. An hierarchical rating scheme can be produced, however, by rearranging the rating scores in the order 2, 0, 1, 3, 4. It is suggested that this reordering of data quality levels be used by those users more comfortable with an hierarchical scheme rather than creating a new rating system. This will avoid the confusion of several rating schemes within the data inventory series and provide continuity with the inventories already published.

This rating system is intended as a guide and not an absolute statement of data quality; it is one of several ways to represent the quality of acquired chemical data. The ideal rating system would use only objective criteria. This is, however, not possible because of the lack of standard analytical procedures in use and because of the significant changes in sample collection and storage techniques and philosophy that have occurred in recent years. Consequently, a certain subjectivity is inherent in the appraisal of data. Any given system for objective data quality appraisal is almost doomed to fail as soon as it is chosen because it will rely to some degree on the discretion of the appraiser. This is particularly true in this retrospective evaluation of data quality, because details of sample history are poorly documented and additional clarification cannot be readily obtained.

Ultimately, the quality of the data will reflect the weakest link in the methodology chain (see 6.3 below). Thus, in cases where a deviation from acceptable methodology is considered so serious that the validity of the obtained results is in doubt, a value of 0 is assigned. Consider the collection of seawater samples for heavy metal analyses, for example. Suppose that the samples were stored acidified in

unprepared PVC bottles. During the storage period, some metals would leach out of the PVC material which forms the walls of the bottle, so introducing positive contamination to the sample. Because all sampling bottles can differ slightly and sometimes greatly in their composition of impurities, the magnitude of the contamination can be random among samples; not even comparison of concentration values within the sample set can be justified in a relative sense. The clear lack of confidence in the results, together with the strong suspicion that the samples are no longer representative of the original water mass, would result in the assignment of a data rating value of 0. It should be noted that the chemical analyses could have been carried out with well-accepted analytical techniques and using the finest state-of-the-art instrumentation. In fact, the analyses could be very precise and very accurate based on the analysis of certified reference materials. Unfortunately, despite the excellence of the analysis, the results would still be hopelessly wrong.

With reference to this inventory of chemical oceanographic data for the Queen Elizabeth Islands region, cases as obvious as the example above were rare. The most common characteristic of the data sets was an insufficient description of how the results were generated. This led to the assignment of a data rating of 2 to most measurements. It must be stressed, however, that a 2 rating is no better than a 0 rating unless missing information is supplied. If that information no longer exists or in fact never existed, a 0 rating would be warranted. Those readers interested in data sets rated 2 or below are advised to inspect the data very carefully and investigate the data to a level required by the use to which they intend to put the data.

As already noted, merely stating that a given analytical method was used for a chemical analysis is not sufficent information to reach an opinion about the quality or validity of the data. The quality of analysts varies widely. What can be attained by one analyst can be beyond the abilities of others, even when "identical" procedures are employed. This has been demonstrated on more than one occasion during inter-laboratory calibration exercises.

6.3 Significance of the Data Rating Value

The usefulness of the data will depend on the use for which the data are intended, i.e., which question or environmental concern is being considered. The data rating value may be seen to separate groups of data; this can lead to different

degrees of understanding environmental processes. It should be recognized that the rating system is not specific to chemical data. Rather, the system seeks to distinguish fundamental differences in information such as those data sets which contain invalid data; those which limit comparisons of numbers to within themselves; and those which allow comparison between data sets.

At least three levels of data quality are essential to establish significance of data:

Level 1: Identification of Ranges of Values

At this least discriminating level, the data can be assessed for whether their reported ranges fall within the general limits expected for coastal or estuarine areas. Gross errors, contamination, or methodology problems would be identified. Even if the ranges of data were physically possible, this level of data scrutiny does not provide any site-specific information, or determine whether the data were representative of a given geographic area, depth or particular time of year when the data were collected. Most data, even those scoring 1 or 2 could be tentatively used in such a way.

Level 2: Comparison of Data within the Data Sets

At this level, comparison of profiles or time series within a given data set could be used to determine whether measurements of water or sediment properties at particular stations were significantly different from each other on the basis of precision of measurement. Data with a rating of 3 could be used in this instance provided the precision was sufficient to resolve differences within the range of measured values.

Level 3: Comparison of Data Between Data Sets

This is the minimum rating level required for studies of long-term variability of chemical components. It is also required for studies describing processes that control lateral and vertical distributions of chemical components. Studies involving the detection of subtle shifts in chemical equilibria that may lead to downstream effects (such as perturbations to biological systems or climatological changes) also

require data with a high level of confidence and a measure of absolute accuracy. Only data with a rating of 4 could be considered for such applications. Even these data, however, will be inadequate if the samples are not representative of the environmental medium sampled. Full interpretation of chemical oceanographic data is impossible in isolation from knowledge of water column structure. Thus, when concurrent measurements of temperature, salinity and perhaps nutrients and dissolved oxygen or some other related variable are not available to support the chemical data, even 4-rated data will be of limited value. In such cases, conclusions will be tentative, being based primarily on inference and conjecture.

6.4 Effect of Station Positioning on the Data Quality

Accuracy of the station positions is a factor essential to the proper use of data. This is particularly relevant when knowledge of spatial distributions of water or sediment properties are essential for the understanding of a particular oceanographic phenomenon. Many station positions were obtained using rudimentary techniques such as dead reckoning, or radar range and bearing at distances far from shore. Consequently, there may be considerable uncertainty about the geographical location at which samples were obtained. This leads to the dilemma that some chemical data which have received a 4-rating may in fact be of little value in defining important spatial distributions.

6.5 Some Important Factors Relevant to the Data Appraisal Process.

The sampling and sample processing techniques used in chemical oceanography are not universally applied to all parameters. Reliable results for certain parameters require the successful application of stringent and highly specialized precautions, whereas reliable results can be obtained for others using standard routine methodologies. Following is a brief discussion of some of the factors that one must consider when evaluating specific chemical oceanographic data. Examples of difficulties that can occur during processing of samples for the most commonly observed parameters in Table 2 (heavy metals, nutrients, dissolved oxygen, hydrocarbons, chlorinated hydrocarbons) are also presented.

6.5.1 Heavy Metals

A. Sea Water

Many of the pitfalls associated with obtaining reliable heavy metal data in sea water can be illustrated by following the history of a water sample from the time of collection through to the completion of the analysis.

The first step facing the chemical oceanographer is the collection of a representative sample. Although this is probably the most important link in the chain of analytical operations, historically it has been given far less thought and care than it deserves. The sampling device must be constructed of materials that will not contaminate the sample. Thus, all metallic components of commonly-used samplers must be removed or replaced. In addition, samplers must be thoroughly cleaned and kept clean between sampling casts. Teflon is an excellent construction material for samplers because it is usually manufactured with only very low trace metal impurities and can be hot acid cleaned. Nevertheless, samplers made from this material must be carefully cleaned because during the fabrication of Teflon into a chemical apparatus, particles of grit, rust and dirt may become embedded in the surface to act as a source of contamination for long periods of time. The standard Niskin-type water sampler, which has been used extensively in oceanographic sampling, usually contains an internal rubber-coated metal spring or rubber shock cord as part of the closing mechanism. Both are unacceptable since metal impurities can be present in these materials (for example, zinc oxide at percent levels). Thus, the use of these samplers for the collection of sea water for zinc analysis is not recommended unless the standard internal spring has been replaced by a Teflon-coated spring or similar contamination-reducing component. Because the sea surface microlayer is enriched with heavy metals, it is advisable to obtain subsurface seawater samples by using samplers such as the Niskin GO-FLO sampler that passes closed through the sea surface layer. Peristaltic pumping systems employing acid-cleaned polyethylene or Teflon tubing have also been used to avoid some of the contamination associated with the surface layer and general handling; these are usually practical only for shallow depths.

The necessity for carefully choosing a sampler is clearly apparent from the results of recent sampler intercomparison studies. Spencer et al. (1982) report that surface water samples taken with a Teflon-coated Niskin GO-FLO sampler possessed

much higher concentrations of zinc (7-10 fold) and lead (2-3 fold) than those collected directly in Teflon bottles. Bewers and Windom (1982) compared GO-FLO, Niskin and Hydro-Bios samplers. Their results show that the lower concentration seawater samples (Cd, Cu, Ni, Zn, Fe, Mn, Hg, Mo, and V) were collected using GO-FLO bottles in which O-rings and seals were replaced by silicone equivalents; drain cocks were replaced by those made of solid Teflon. Modified Niskin samplers appeared to be only slightly inferior to the modified GO-FLO, but unmodified GO-FLO and Hydro-Bios samplers were generally poorer.

Other precautions that should be observed during the collection of seawater samples for heavy metal analyses include:

(i) use of plastic-coated steel rope, Kevlar rope or stainless steel wire rope in place of the standard iron hydrographic wire (Bewers and Windom, 1982);

(ii) stainless steel weights wrapped in plastic to weigh the hydrographic wire;

(iii) obtaining surface samples from a small boat by heading into the wind against local surface currents and holding the sample bottle so that it precedes the boat through the water.

Once collected, the sample must be transferred to a storage bottle for some period of time. The storage container must be prepared before use in order that the possibility of the bottle contaminating the sample is reduced. This usually involves a multi-stage and multi-day hot acid-cleaning procedure as described by the Participants in the Lead in Seawater Workshop (1976). Cleaned containers are stored wrapped in polyethylene film and handled only with polyethylene-gloved hands. A preservative is usually added to the samples to inhibit biological activity and the absorption of heavy metals onto the walls of the storage containers. The preservative is most often HCl and must be of sufficient purity to ensure that any trace metal impurities associated with the addition of acid are insignificant relative to the quantity of metal present in the sample.

Most heavy metals samples can be stored in Teflon, polyethylene or quartz when properly cleaned. Mercury should not be stored in polyethylene because mercury vapour readily passes into and through the walls of these containers. The question of whether the sample should be filtered before acidification is controversial. The procedures involved during filtration (particularly on a dirty ship or other field environment where laboratory conditions are not easily reproduced)

may often result in greater contamination than would otherwise result from the acidification of unfiltered samples. Sometimes filtration cannot be avoided. On these occasions, filtrations should be carried out (a) under reduced pressure in a closed system apparatus which allows the sample to flow directly from the sample bottle through a pre-cleaned filter into a second pre-cleaned storage bottle or (b) using positive pressure (compressed filtered N_2) in a device that allows direct filtration of a seawater sample from the sampler into a storage bottle. Ideally, the elapsed time between sample collection and analysis should also be minimized to reduce the possibility of sample modification during storage. For instance, prolonged storage may favour the formation of very strong or kinetically-hindered metal complexes with naturally-occurring chelating agents which may, in turn, prevent the formation of an extractable complex with a chelating agent, inhibit a colour forming reaction or impede the reduction of an ion at an electrode. The ultimate result may be that normal analytical methods produce low results or miss a component entirely.

The analytical methodology must also be considered in view of current practices. Any analytical method may be internally consistent yet produce vastly different results from another method, making intercomparison difficult. An example is reported by Brewer and Spencer (1970) where results for the determination of cobalt in sea water obtained from the chelation/extraction/atomic absorption method were five to six fold greater than those obtained by neutron activation of the freeze-dried salts of replicate samples. Even primary reference standards may not be able to resolve such a discrepancy because of matrix interferences, for example. Contamination arising during analysis from atmospheric fallout, reagents, sample handling etc. must also be controlled. The recent trend toward performing heavy metal analyses in laminar flow work stations or Clean Rooms is understandable. Even so, it is not unusual to find members of the most advanced and prestigious marine analytical laboratories in the world disagreeing with each other by factors of 5 or more on the concentrations of metals in standardized seawater samples during international intercalibration exercises (Sugawara, 1978; Bewers et al., 1981; Olaffson, 1982). Deviations from the standardized or accepted values can exceed ±100% in these intercalibration studies.

The facts presented above emphasize several important points. Steps should always be taken to limit handling and the addition of preservatives to samples. It is also very difficult to form an objective opinion about the quality of a trace metal data set when details such as the ones described above are not given. A true

perspective of the heavy metal data as a whole can be achieved by considering the scientists' awareness of problems associated with sampling, storage and sample handling at the time the samples were collected. As the importance of controlling contamination became evident over the years, more effort has been made to systematically eliminate or reduce as many contaminant sources as possible. The result has been a continued decrease in the reported values for heavy metals in sea water over the past 40 years (see Table 6.1). During the past several years, artfully and carefully analysed samples for heavy metals have generated results conclusively showing that heavy metals are not erratically distributed in the oceans as was the earlier uncomfortable conclusion drawn by many chemical oceanographers based on data dominated by contamination effects. Rather, horizontal and vertical distributions are now known to vary systematically and can be explained by geological, chemical and physical phenomena. Such evidence of physical and geochemical controls on heavy metal distributions leads to further confidence in metal data and is an aid when evaluating data collections.

B. Sediment and Biological Tissues

In general, the pitfalls encountered in the sampling, storage and analysis of marine sediment samples are fewer than those encountered with seawater samples because the concentrations are commonly about three orders of magnitude higher. Obtaining a representative sample, however, still remains a challenge. Many grab samplers such as the Ponar, screen top Van Veen, Petersen and Kahl box sampler collect both substrate and overlying water. Extreme care must be taken that the overlying water does not wash out the fine material within the surface layer during removal of sediment sample from the sampling device. Before sample collection, it is wise to consider the types of analyses that will be performed on the sample so that a suitable sub-sampling strategy can be devised. Walton (1978), for example, suggests that material from the outer portions of the sample can be used for physical analyses, whereas interior material which is more protected from disturbance or contamination can be used for metal or hydrocarbon analyses. Subsampling for one type of compound should not contaminate the remaining sample before removing a subsequent subsample. Some analysts prefer to analyse a subsample from a homogenized whole sediment; others analyse a given grain size fraction. Because trace metal content usually increases with surface area of particles, intercomparison

TABLE 6.1

BASELINE CONCENTRATIONS OF SELECTED TRACE METALS IN OPEN-OCEAN WATERS REPORTED DURING THE LAST FORTY YEARS

REFERENCE	UNITS	Cd	Cu	Pb	Zn	Ni
COMPILED DATA						
Sverdrup et al., 1942	µmol tonne-1	present	157	1.9	85.0	---
Goldberg, 1965	µmol m-3	0.98	47	0.14	133.0	---
Brewer, 1975	µmol m-3	0.89	7.9	0.14	75.	---
RECENT ORIGINAL DATA						
Zirino and Healy, 1971	µmol m-3	---	---	---	26.0	---
Chester and Stoner, 1974	µmol m-3	0.62	12.6	---	21.0	---
Eaton, 1976	µmol tonne-1	0.53	---	---	---	---
Bender and Gagner, 1976	µmol m-3	<0.90	1.9	---	---	---
Windom and Smith, 1979	µmol tonne-1	---	0.3 - 5.2	---	---	---
Bruland et al., 1978	µmol m-3	---	---	---	0.15 - 9.2	---
Bruland, 1980	µmol tonne-1	0.002 - 1.11	0.54 - 5.3	---	0.08 - 9.1	---
Boyle et al., 1981	µmol tonne-1	<0.01 - 0.08	0.05 - 1.5	---	---	1.03 - 3.5
Danielsson, 1980	µmol tonne-1	0.07 - 0.84	1.3 - 5.5	0.10 - 0.82	---	3.1 - 16.2
Kremling and Petersen, 1978	µmol m-3	0.03 - 0.04	1.6 - 2.7	---	0.76 - 2.0	---
Patterson, 1974	µmol m-3	---	---	0.07	---	---
Heggie, 1982	µmol tonne-1	---	2 - 25	---	---	---

of many data sets is often tenuous when different size fractions have been analysed. Also, errors may result when sieves made from copper or brass cloth are used to segregate grain sizes. For the analysis of heavy metals in benthic biota, it is important that the animals be purged of gut contents before analysis, lest the inorganic sediment present in the gut be included in the estimation of biological metal. For small specimens, it is often possible to obtain more reliable results by digesting the whole specimen(s) and subsampling the digest, as opposed to subsampling the specimens before the digestion step. For larger animals such as fish and marine mammals, specific organs are usually examined due to the vast range of values possible for various body organs. Special precautions must be taken to check for interferences resulting from the presence of natural oils.

For both sediment and biological metals, methods involving conditions which favour the formation of covalent halides (e.g., hot sulphuric, perchloric or phosphoric acid in the presence of halide ions) should be examined carefully given the possible quantitative distillation of chromium, arsenic, antimony, tin, selenium, rhenium and osmium and the vaporization of substantial amounts of germanium, molybdenum and mercury under such conditions, particularly when Teflon digestion bombs are not employed in the procedure.

6.5.2 Nutrients

The measured concentration of a given nutrient in a sea water sample is very dependent on analytical methodology. The term "reactive nutrients" is often used to emphasize that results refer to those quantities of nutrient that react under the conditions of specific analytical methods. Phosphate is usually measured as soluble inorganic orthophosphate ions which react with acidified molybdate reagent to yield a phosphomolybdate complex which is then reduced to a highly coloured blue compound. Currently used methods for ammonia determination (such as the indophenol blue method) usually measure NH_3 plus NH_4^+. Earlier methods included varying amounts of labile organic nitrogen compounds such as trimethylamine and amino acids in the determination. Nitrite is determined as an azo dye formed by the stepwise stoichiometric reaction of nitrite ion with an aromatic amine. Nitrate is determined by the same method as nitrite after passing the sample through a catalytic reductor column to reduce nitrate to nitrite. Since many procedures do not measure nitrite separately, the results for nitrate would be stated more accurately as nitrate plus

nitrite. The error involved is usually not significant, however, because nitrite is present only at about 5% of the concentration of nitrate. Silicon is determined as dissolved inorganic silicate based on the formation of a yellow silicomolybdic acid when an acidic sample is treated with molybdate solution. Colloidal silicic acid in sea water usually reacts, but polymeric chains containing three or more silicic acid units react very slowly.

The procedures used for sampling and storage of nutrients in sea water are often modified for specific applications. Some general points are noteworthy:

(a) for best analytical results, samples should be analysed within about one hour of collection;

(b) short-term storage should be in a cool, dark place;

(c) if long-term storage by freezing is necessary, it should be limited to a maximum of two months to limit variance caused by storage (Macdonald and McLaughlin, 1982);

(d) quick-freezing is an effective method for long-term storage of all nutrients except for silicate in estuarine water having a salinity of less than 27 x 10-3. Caution must also be observed for samples containing silicate in excess of approx. 70 mmol m-3 or stored for longer than five months. In these cases, data may be successfully recovered provided that thaw times are long enough. The addition of preservatives to samples should be avoided to reduce the chance of contamination and possible interference with the analytical technique. In particular, acidification of phosphate samples is not recommended because of the tendency to favour hydrolysis of combined phosphorus. The addition of chloroform to phosphate samples should also be avoided, because this requires a preliminary sample filtration step which should be avoided if possible. Where water is visibly turbid, PO_4 samples must be filtered. This is particularly important in estuarine samples;

(e) silicate samples must be stored in plastic; phosphate samples keep best in plastic as uptake of phosphate by glass surfaces has been observed; nitrite/nitrate samples can be effectively stored in glass or plastic;

(f) before analysis, silicate samples should be thawed for a minimum of three hours to allow for depolymerization (exact time depends on length of time stored in the frozen state).

Although nutrient elements have been analysed frequently by many laboratories for many years, they cannot be determined routinely with sufficient

confidence to resolve differences in nutrient water column structure. This is illustrated by the results of a 20-nation nutrient method intercalibration exercise conducted by ICES (International Council for the Exploration of the Sea, 1977); it showed that only 9% of the total variance of laboratory values was attributable to the "within laboratory" component of variance. Thus, the ability of each laboratory to obtain a precise result was much better than the overall accuracy observed during the intercalibration exercise. Coefficients of variation (CV) for the determination of the different nutrients ranged from 4% to 21%. Because the intercalibration was not a blindfold test, these CV's probably overestimate the precision that would be expected under routine laboratory conditions.

6.5.3 Dissolved Oxygen

Almost without exception, the chemical determination of oxygen in sea water is based on the Winkler titration (Carritt and Carpenter, 1966). Samples must be carefully obtained, fixed and stored, all the while limiting or eliminating contact with atmospheric oxygen until after formation of the tri-iodide complex. Numerous systematic errors can occur during the determination of dissolved oxygen by the Winkler titration method; most result in an overestimation of oxygen content. Utmost care must be taken in the preparation of iodate solution for standardization by using only the highest quality primary standards.

In situ oxygen probes have also been used to measure dissolved oxygen. Because sensor calibrations often wander or because compensation for changes in temperature and salinity are insufficient or too slow, the sensitivity and accuracy of the in situ probe may be insufficient to resolve dissolved oxygen concentrations in the water column or during surface tows. Oxygen concentrations obtained from in situ probes should be treated as approximate unless compelling evidence is provided to indicate otherwise.

6.5.4 Hydrocarbons

A. Sea Water

In the past, the methodologies used by various researchers for sampling, sample preservation and storage, and cleaning procedures have generally been used on

an ad hoc basis, each designed and implemented to suit a particular study or application. The best samplers appear to be made of glass or stainless steel which can be effectively solvent cleaned. Contamination during sampling is a serious and commonly encountered problem. Hydrowire can be easily contaminated by oil and grease found in plentiful quantities on the sampling vessel and particulate fallout from combustion of the ship's fuel can also be present. Care should be taken to ensure that all sampling equipment is kept clear of ship's exhaust when travelling between stations. Kevlar or stainless steel cable is preferred for sample casts in conjunction with samplers that pass closed through the sea surface to avoid being contaminated by the natural and anthropogenic hydrocarbon componds which concentrate in slicks at the surface. Such sampling procedures are particularly important for ship-based operations where a halo of surface oil can quickly form at a station and extend a considerable distance away from the vessel. Samples should be stored in the dark and in the cool. They should contain added bactericides such as mercuric chloride, sodium azide, chloroform or methylene chloride to limit alteration of the sample through photolysis or bacterial action. Wong et al. (1976) reported that as much as 30% of dissolved PAH was removed from solution by adsorption onto the walls of the storage container during the sample storage period. It is prudent, therefore, to wash sample containers with solvent during the analytical step to recover analyte that would otherwise be lost and lead to an underestimation of the dissolved PAH content of the samples.

B. Sediments and Biota

Hydrocarbons in sediments and biota present fewer contamination problems than seawater samples because, like metals, concentrations are very much greater than in sea water. Sediments can be successfully collected with grab samplers with the same reservations as outlined above for sampling sediments for heavy metals. No special precautions beyond those already mentioned above need be taken for biological samples.

During the analysis step, however, several pitfalls may occur. Soxhlet extraction of sediments is common. There is some evidence that this may encourage an in situ contamination through the formation of PAH (polyaromatic hydrocarbons) compounds. Results for low boiling compounds (low molecular weight compounds) should be considered highly unreliable if rotary evaporation techniques have been used to reduce extract volumes.

It is very difficult to compare hydrocarbon results among various studies. Results are often presented for classes of compounds such as aliphatics, polyaromatics, chlorins, fatty acids etc. Column chromatography separations vary from one method to another resulting in the aliphatics determined by one procedure not being equivalent to the aliphatics measured in another. Quantification of specific compounds may be based on the co-injections of standards in a GC (gas chromatograph) or by reference to an internal standard. Total PAH is defined by some authors as the sum of all resolved peaks, a specifically identified assemblage of PAH or the sum of resolved and unresolved PAH. Different methods generate different looking results. For instance, PAH by fluorescence may generate results in units of a standard pure PAH compound such as chrysene while PAH by GC produces results for specific compounds. An example given by Awad (1981) illustrates that it can be impossible to obtain the same results applying two different techniques on the same sample even if they differ in just a single step. In the two techniques by Blumer et al. (1971) and Vandermeulen et al. (1976) applied to sediments, the extraction steps were different but the purification steps were the same. The weights of organic extracts and yield of hydrocarbons produced from the first technique, however, were three to seven times higher than those obtained from the second.

Intercalibrations using different analytical techniques for hydrocarbons are usually unsuccessful. An example is the analysis of sediment samples from an area affected by the ARGO MERCHANT oil spill using u.v. fluorescence spectroscopy and gas chromatography. Although the samples used were considered to be identical, the two research groups carrying out the analyses reported no significant correlation of results for values less than 100 µg/g. In addition, Zsolnay (1978) reported no significant correlation between the results obtained by GC and high performance liquid chromatography (u.v. detector) when analysing organism tissues.

Extreme caution must be exercised when comparing concentrations for various hydrocarbon groupings or compounds among the various data sets.

6.5.5 Chlorinated Hydrocarbons

The analysis of chlorinated hydrocarbons such as pesticides and polychlorinated biphenyls presents great difficulty, because concentrations of these substances in sea water are very low (parts per 10^9 or less), leading to the need for large sample sizes (10 litres or more). Problems arise from the handling of these

large volumes during the complicated multi-stage analytical procedures employed in the determination of chlorinated hydrocarbons. Procedures are often more art than science where the skill of the analyst becomes paramount to the end result. Contamination of samples can be a serious hazard because of the previous widespread use of chlorinated hydrocarbons in the manufacture of industrial and commerical products. In recent years the manufacture of most chlorinated hydrocarbons and their use in other products has been controlled by legislation, so that the chances of contamination during sampling sea water should be decreasing.

Because chlorinated hydrocarbons are hydrophobic and lipophilic, they tend to concentrate at particle surfaces and in the fatty tissues of organisms. Consequently, their determination in biological tissues and sediments is much simpler than for sea water, although procedures remain complicated and non-routine. Results can be erratic unless careful attention is paid to each step of a procedure.

Regardless of the medium sampled, exact details of sampling, storage and analysis must be specified in order that data quality can be assessed. Quantification is very difficult because of the many isomers and interferences normally encountered in chlorinated hydrocarbon assemblages. Demonstrated effective control of low level blanks can increase confidence in the results.

7. REFERENCES

Data set numbers (where applicable) are given in bold type at the end of the reference.

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8. DATA INVENTORY TABLE 1.

DATA SET LISTING

NOTE: Entries appearing in column 5 in **bold type** indicate those chemical quantities reported in Table 2. Entries in regular type refer to quantities reported to have been sampled, but for which no data were provided by original investigators.

Description of Table 1 Headings

Table 1 provides general details of sampling excursions and includes:

(1) identification of the specific region within the study area where sampling was conducted;

(2) the period of time during which the measurements were made;

(3) the ship or agency which collected the data;

(4) a listing of the chemical quantities measured or sampled during the collection period, with those quantities for which data are published and available for inclusion in this inventory in bold type. All entries are not in bold type because

  (a) all samples collected on original cruises may not have been analysed;

  (b) samples may have been analysed but results may not be available in the public domain or may be untraceable;

  (c) samples may be lost or destroyed.

(5) concurrent physical and biological measurements or samples.

LIST OF ABBREVIATIONS USED IN TABLES 1 and 2

Al	-	aluminum
alk_t	-	total alkalinity
As	-	Arsenic (AW= 197.20)
ATP	-	adenosine triphosphate
Ca	-	calcium (AW = 40.08)
Cd	-	cadmium (AW = 112.4)
CH_4	-	methane
Chl. a	-	chlorophyll a
Chl. b	-	chlorophyll b
Chl. c	-	chlorophyll c
CO_2	-	carbon dioxide
Co	-	cobalt (AW = 58.94)
Cr	-	chromium (AW = 52.00)
Cu	-	copper (AW = 63.54)
Fe	-	iron (AW = 55.85)
^2H	-	deuterium (AW = 2.00)
^3H	-	tritium (AW = 3.00)
He	-	helium
Hg	-	mercury (AW = 200.59)
Li	-	lithium
Mg	-	magnesium
Mn	-	manganese
N	-	nitrogen (AW = 14.01)
NH_3	-	ammonia
Ni	-	nickel
NO_2	-	nitrite
NO_3	-	nitrate

$\delta^{18}O$	-	18O/16O isotopic ratio
O_2	-	dissolved oxygen
OC	-	organic carbon
Pb	-	lead
phaeo.	-	phaeopigments
PO_4	-	phosphate
Si	-	silicon (AW = 28.09)
SiO_3	-	silicate
Ti	-	titanium (AW = 47.90)
V	-	vanadium
Zn	-	zinc

DATA SET I.D.	COLLECTING AGENCY, SHIP	COLLECTING PERIOD	AREA	CHEMICAL QUANTITIES MEASURED OR SAMPLED	CONCURRENT MEASUREMENTS		REMARKS
					BIOLOGICAL	PHYSICAL	
52-0003	U.S.S. Edisto	August 17-20	Eureka Sound	Water Column: O_2	Plankton	Water Column: temperature salinity transparency	Cores collected
60-00667	POLAR CONTINENTAL SHELF PROJECT	April 18-May 30	Peary Channel, Prince Gustaf Adolf Sea	Water Column: O_2	Plankton	Water Column: temperature salinity	MEDS 60-181160338
61-0009	PACIFIC OCEANOGRAPHIC GROUP, Ice camp	April 13-May 3	Prince Gustaf Adolf Sea	Water Column: O_2	Plankton	Water Column: temperature salinity current speed current direction acoustics	
61-0077	POLAR CONTINENTAL SHELF PROJECT	May 20	Prince Gustaf Adolf Sea	Water Column: O_2			MEDS 61-181161339
61-0078	DEVON ISLAND EXPEDITION Ice camp	Nov. 13, 1961-June 29, 1962	Jones Sound	Water Column: O_2, PO_4, NO_3, SiO_3			MEDS 63-182361473
62-0005	ARCTIC UNIT MONTREAL, Land based camp using small craft	July 2-August 16	Nansen Sound (Slidre Fjord)	Water Column: O_2	Plankton Benthos Fish Mammals, terrestrial	Water Column: temperature salinity	
62-0006	C.C.G.S. John A. MacDonald	August 14-31	Nansen Sound, Norwegian Bay, Wellington Channel, Penny Strait, Kellett Strait	Water Column: O_2	Plankton	Water Column: temperature salinity	

DATA SET I.D.	COLLECTING AGENCY, SHIP	COLLECTING PERIOD	AREA	CHEMICAL QUANTITIES MEASURED OR SAMPLED	CONCURRENT MEASUREMENTS		REMARKS
					BIOLOGICAL	PHYSICAL	
62-0066	ARCTIC BIOLOGICAL STATION, Inflatable boat or canoe	July 18	Sverdrup Channel (Strand Fjord)	Water Column: O_2		Water Column: temperature salinity	
62-0067	ARCTIC BIOLOGICAL STATION, Inflatable boat or canoe	August 10	Nansen Sound (Slidre Fjord)	Water Column: O_2		Water Column: temperature salinity	
63-0057	C.C.G.S. Labrador	Sept. 24-26	Jones Sound	Water Column: O_2		Water Column: temperature salinity	MEDS 63-181063005
64-0005	PACIFIC OCEANOGRAPHIC GROUP, Ice camp	Feb. 3-19	Prince Gustaf Adolf Sea	Water Column: O_2	Plankton	Water Column: temperature salinity	Icepack V
64-0008	DEFENCE RESEARCH ESTABLISHMENT, OTTAWA, Motor toboggan, Freight canoe	May 24-August 25	Nansen Sound	Water Column: O_2	Plankton	Ice: thickness other Water Column: temperature salinity water level	Operation Tanquary, glaciology and botany observations

DATA SET I.D.	COLLECTING AGENCY, SHIP	COLLECTING PERIOD	AREA	CHEMICAL QUANTITIES MEASURED OR SAMPLED	CONCURRENT MEASUREMENTS		REMARKS
					BIOLOGICAL	PHYSICAL	
68-0001	FISHERIES RESEARCH BOARD, C.C.G.S. Labrador	August 16-Sept. 10	Wellington Channel, Norwegian Bay, Jones Sound	Water Column: O_2	Benthos	Water Column: temperature salinity	Icepack 8/68
71-0107	C.C.G.S. Louis St. Laurent	Sept. 2	Jones Sound	Water Column: O_2		Water Column: temperature salinity	MEDS 71-180771002
72-0011	FISHERIES AND MARINE SERVICE PACIFIC REGION, C.C.G.S. Louis St. Laurent	Sept. 28	Wellington Channel	Water Column: O_2, SiO_3, PO_4, NO_3, NO_2	Plankton	Water Column: temperature salinity transparency	
73-0128	FROZEN SEA RESEARCH GROUP, INSTITUTE OF OCEAN SCIENCES	April 4-15	Greely Fjord	Water Column: O_2		Atmosphere: wind speed wind direction precipitation atm. conditions other	

DATA SET I.D.	COLLECTING AGENCY, SHIP	COLLECTING PERIOD	AREA	CHEMICAL QUANTITIES MEASURED OR SAMPLED	CONCURRENT MEASUREMENTS		REMARKS
					BIOLOGICAL	PHYSICAL	
73-0128 cont'd.						Ice: salinity thickness other Water Column: temperature conductivity	
74-0014A	MARINE SCIENCES McGILL, Ice camp	May 14	Austin Channel	Water Column: Chl. a, PO_4, NO_3+NO_2, SiO_3 Ice core: Chl. a, Chl. b, Chl. c, Phaeo., PO_4, NO_3+NO_2	Phytoplankton Zooplankton Benthos	Ice: thickness Water Column: temperature salinity	For Polar Gas Project
74-0023	MARINE SCIENCES McGILL, Ice camp	May 7-20	Austin Channel	Ice core: NO_3, Chl. a, Phaeo.	Epontics	Ice: salinity thickness snow cover	
74-0118	PLURITEC CONSULTANTS, Small craft	August 14-28	Danish Strait (Jackson Bay)	Water Column: O_2, pH	Microbes Phytoplankton Benthos Birds Mammals, terrestrial	Water Column: temperature conductivity turbidity transparency color	Baseline survey for Panarctic Oils Limited drillsite

DATA SET I.D.	COLLECTING AGENCY, SHIP	COLLECTING PERIOD	AREA	CHEMICAL QUANTITIES MEASURED OR SAMPLED	CONCURRENT MEASUREMENTS		REMARKS
					BIOLOGICAL	PHYSICAL	
74-0121	DOBROCKY SEATECH LTD. for B.C. RESEARCH, Diver	August 17-22	Crozier Strait (Cominco Bay)	Water Column: **O_2, pH, As, Cd, Cu, Fe, Pb, Zn** Bottom Sediment: **Cd, Cu, Fe, Pb, Zn** Biota (Zoobenthos): **Cd, Cu, Fe, Pb, Zn**	Plankton Zoobenthos Phytobenthos Fish (marine) Birds Mammals, pinnipeds	Water Column: temperature salinity	Reconnaissance for Polaris Mines Ltd.
75-0137	FROZEN SEA RESEARCH GROUP, INSTITUTE OF OCEAN SCIENCES, Ice camp	April 11	Greely Fjord (d'Iberville Fjord)	Water Column: **O_2**		Atmosphere: wind speed wind direction precipitation atm. conditions other Ice: thickness other Water Column: temperature conductivity other	
75-0138	FROZEN SEA RESEARCH GROUP, INSTITUTE OF OCEAN SCIENCES, Canoe	June 13	Greely Fjord (d'Iberville Fjord)	Water Column: **O_2**		Atmosphere: wind speed wind direction precipitation atm. conditions other Water Column: temperature conductivity	stream flow measurements also taken

DATA SET I.D.	COLLECTING AGENCY, SHIP	COLLECTING PERIOD	AREA	CHEMICAL QUANTITIES MEASURED OR SAMPLED	CONCURRENT MEASUREMENTS		REMARKS
					BIOLOGICAL	PHYSICAL	
76-0010	LGL LIMITED, (for POLAR GAS PROJECT)	June 2-22	Austin Channel	Water Column: Chl. a, NO_3, PO_4, SiO_3	Phytoplankton Zooplankton Benthos Fish		
76-0117	FROZEN SEA RESEARCH GROUP, INSTITUTE OF OCEAN SCIENCES, Ice camp	March 12	Greely Fjord	Water Column: O_2		Atmosphere: wind speed wind direction precipitation atm. conditions other Ice: thickness other Water Column: temperature conductivity	
77-0014	ATLANTIC OCEAN-OGRAPHIC LABORATORY, C.S.S. Hudson	Sept. 13-14	Jones Sound, Fram Sound	Bottom Sediment: OC, CO_2, Si, Al, Ti, Fe, Ca, Mg, Pb, Li, Hg, Mn, Zn, Cu, Co, Ni, Cr, V, Cd, oil Water Column: CH_4, O_2, oil, alk_t, CO_3	Phytoplankton	Water Column: temperature conductivity irradiance	Cruise 77-024 Loring 1984 and unpublished data Levy 1979 AOL, Physical Chemistry Data Listing, Cruise 77-024

DATA SET I.D.	COLLECTING AGENCY, SHIP	COLLECTING PERIOD	AREA	CHEMICAL QUANTITIES MEASURED OR SAMPLED	CONCURRENT MEASUREMENTS		REMARKS
					BIOLOGICAL	PHYSICAL	
77-0014 cont'd.				$\delta^{18}O$			AOL, Isotope Chemistry Data Listing, Cruise 77-024
				SiO_3, PO_4, NO_3			AOL, Nutrient Chemistry Data Listing, Cruise 77-024
				NH_3, CN. a			Irwin et al. 1978
				δ^3He, He, Ne, ^3H, Mn, Fe, Ni, tar balls			Top et al. 1980, Campbell and Yeates 1982, Levy 1979
77-0117	FROZEN SEA RESEARCH GROUP, INSTITUTE OF OCEAN SCIENCES, Canadair F-23 Tracked vehicle	March 16-27	Greely Fjord (D'Iberville Fjord)	Water Column: PO_4, NO_3, SiO_3, ^3H, O_2, ^2H		Water Column: temperature salinity conductivity sound velocity	Analysis of nutrients by Seakem Oceanography Ltd.
82-0106	ARCTIC SCIENCES LIMITED for INSTITUTE OF OCEAN SCIENCES, Twin Otter	March 22-25	Penny Strait, Maclean Strait, Byam Martin Channel	Water Column: SiO_3, NO_3, PO_4		Water Column: temperature salinity	

DATA SET I.D.	COLLECTING AGENCY, SHIP	COLLECTING PERIOD	AREA	CHEMICAL QUANTITIES MEASURED OR SAMPLED	CONCURRENT MEASUREMENTS		REMARKS
					BIOLOGICAL	PHYSICAL	
82-0107	FISHERIES AND OCEANS, CENTRAL REGION, Helicopter	April 8-10	Mcdougall Sound, Wellington Channel	Water Column: NO_3+NO_2, PO_4, SiO_3	Phytoplankton Zooplankton	Water Column: temperature conductivity (within 2 days of chemical observations)	Analyses performed by Ocean Chem Ltd. Dartmouth, N. S.
82-0108	ARCTIC LABORATORIES Limited (for DIAND) Snowmobile	June 6-8	Crozier Strait	Bottom Sediment: Pb, Zn, Cd			
83-0056	ARCTIC SCIENCES LIMITED (for Institute of Ocean Sciences) Twin Otter	March 24-April 1	Mcdougall Sound, Maclean Strait	Water Column: SiO_3, NO_3, PO_4		Water Column: temperature salinity	
83-0057	MARINE ECOLOGY LABORATORY, BEDFORD INSTITUTE OF OCEANOGRAPHY, C.S.S. Hudson	August 13-29	Jones Sound	Water Column: Chl. a, C, N, PO_4, NO_3, SiO_3, ATP	Water Column: Phytoplankton	Water Column: temperature conductivity transparency irradiance	

DATA SET I.D.	COLLECTING AGENCY, SHIP	COLLECTING PERIOD	AREA	CHEMICAL QUANTITIES MEASURED OR SAMPLED	CONCURRENT MEASUREMENTS		REMARKS
					BIOLOGICAL	PHYSICAL	
85-0015	DEPARTMENT OF OCEAN-OGRAPHY, Dalhousie University	April 24	Ballantyne Strait	Water Column: Si, NO_3, O_2		Water Column: salinity	

9. DATA INVENTORY TABLE 2.

LISTING OF DATA BY PARAMETER

Description of Table 2 Headings

In Table 2, specific details including analytical results, are given for each quantity measured in each data set. These include:

(1) total number of stations sampled;

(2) total number of samples obtained at all stations;

(3) the number of samples having analytical results greater than the analytical detection limit or greater than 0 when 0 is used to designate the detection limit;

(4) methodology information: details of collection, storage (preservation), and analysis of the sample allowing for judging quality and comparability of data;

(5) the range of reported concentrations. Note that all concentrations are given in Systeme International (SI) units. Conversions between these and previously used units are given in Table 5.1;

(6) the mean and median of the reported concentrations. The median is included because it is not as easily influenced by extreme values as is the mean. It thus represents a better estimate of the middle of a sample population with skewed distribution. Many environmental parameters fall into a log-normal distribution, so the median is probably a better estimate of central tendency. If the number of observations is odd, the median is the middle one of the observations; if the number is even, the median is the average of the two innermost observations. Where a suite of results includes detection limit values, the detection limit is used for computing the mean;

Note: pH is a logarithmic function. It is not meaningful to express a mean value because the mean can be strongly biased to low pH values; consequently means for pH values are not given.

(7) a data quality (confidence) rating based on the rules outlined subsequently (by Section 6.2). The data rating scale uses values from 0 to 4 with 4 indicating data judged to be highest quality, and to have the most versatile potential (refer to Section 6.3).

Note 1: Mean and median values were calculated from mean values reported.

Note 2: Temperature sensor on Montedoro-Whitney analyzer failed during sampling.

Note 3: Ratings for dissolved heavy metals and nutrients were downgraded to 0 if values reported for background conditions exceeded the concentrations listed below. These "upper limit values" are based on generally accepted maximum published values for uncontaminated coastal areas.

Element	Concentration μmol m-3
Mn	180
Fe	180
Zn	76
Cr	19
Cu	79
Pb	5
Cd	9
Ni	85
Co	85
Mo	52
Hg	0.1
As	67
	mmol m-3
SiO_3-Si	70
NO_3-N	30
PO_4-P	0.3

Note 4: No estimate of precision or accuracy was made for the actual data in the data set. The report indicates values for accuracy and precision that might be achievable by some under optimum conditions.

Note 5: Unit conversion ignores density of sea water.

Note 6: This note upgrades the rating score for Bedford Institute of Oceanography nutrient data from 2 to 3. This results from scrutiny of other BIO nutrient data and the authors' familiarity with the procedures, standardizations, analytical details and consistently high performance of the nutrient lab at the Bedford Institute of Oceanography. On the strength of the printed word, only a rating of 2 was given to these data. Other data sets were not investigated to the extent that the BIO nutrient data were investigated because of time and financial limitations. This was totally the judgment of the authors.

Note 7: Sample $^3He/^4He$ relative to atmospheric $^3He/^4He$ (1.384×10^{-6}).

Note 8: Sample labels failed to adher, resulting in uncertainty as to which analyses corresponds to which depths.

DATA SET NO.	MEDIUM SAMPLED	MEASUREMENT		NO. STATIONS	NO. SAMPLES	NO. SAMPLES ANAL.	METHODS USED		INFORMATION			MEASURED VALUES			DATA RATING	REMARKS
		Qty	Units				Collection	Storage	Analysis	Precision	Accuracy	Range	Mean	Median		
52-0001	SEA WATER	O_2	mol m^{-3}	3	15	15	NS	NS	NS	NS	NS	0.29 - 0.44	0.34	0.34	2	
60-0006	SEA WATER	O_2	mol m^{-3}	2	13	13	NS	NS	NS	NS	NS	0.268 - 2.166	0.921	0.277	2	
61-0009	SEA WATER	O_2	mol m^{-3}	4	19	19	Fjarlie bottle	NS	modified WT	NS	NS	0.26 - 0.44	0.31	0.28	2	
61-0077	SEA WATER	O_2	mol m^{-3}	1	5	5	NS	NS	NS	NS	NS	0.109 - 0.180	0.147	0.139	2	
61-0078	SEA WATER	O_2	mol m^{-3}	15	75	75	NS	NS	NS	NS	NS	0.293 - 0.436	0.348	0.343	2	
		PO_4	mmol m^{-3}	15	75	75	NS	NS	NS	NS	NS	0.76 - 13.9	1.04	1.03	2	
		NO_3	mmol m^{-3}	15	60	60	NS	NS	NS	NS	NS	9.1 - 12.0	8.75	8.80	2	
		SiO_3	mmol m^{-3}	15	75	75	NS	NS	NS	NS	NS	10.6 - 36.2	27.8	27.8	2	
62-0001	SEA WATER	O_2	mol m^{-3}	17	165	165	bottle cast	NS	modified WT	NS	NS	0.28 - 0.48	0.41	0.42	2	
62-0006	SEA WATER	O_2	mol m^{-3}	11	115	115	Nansen bottle	winkler analysis	modified WT	NS	NS	0.19 - 0.44	0.32	0.31	2	
62-0066	SEA WATER	O_2	mol m^{-3}	1	9	9	NS	NS	modified WT	NS	NS	0.367 - 0.450	0.413	0.416	2	
62-0067	SEA WATER	O_2	mol m^{-3}	1	5	5	NS	NS	modified WT	NS	NS	0.312 - 0.417	0.381	0.388	2	
63-0057	SEA WATER	O_2	mol m^{-3}	18	185	185	NS	NS	NS	NS	NS	0.180 - 0.398	0.335	0.348	2	
64-0054	SEA WATER	O_2	mol m^{-3}	NS	41	41	Fjarlie Mark IV bottle	frozen and not frozen; with and without reagents; in glass or poly bottles for 0 to 7 days	WT	NS	NS	0.22 - 0.42	0.32	0.34	1	study conducted to evaluate suitability of various methods of sample preservation
64-0008	SEA WATER	O_2	mol m^{-3}	10	69	69	Knudsen bottle	NS	WT	NS	NS	0.21 - 0.44	0.39	0.43	2	
68-0001	SEA WATER	O_2	mol m^{-3}	6	33	33	bottle cast	NS	modified WT	NS	NS	0.01 - 0.44	0.29	0.33	1	oxygen concentrations reported bear no relation to water column density structure; anoxic layer reported

DATA SET NO.	MEDIUM SAMPLED	MEASUREMENT		NO. STATIONS	NO. SAMPLES	NO. SAMPLES vol.	METHODOLOGY		INFORMATION			MEASURED VALUES			DATA RATING	REMARKS
		Qty	Units				Collection	Storage	Analysis	Precision	Accuracy	Range	Mean	Median		
71-0107	SEA WATER	O_2	mol m^{-3}	1	12	12	NS	NS	NS	NS	NS	0.346 - 0.408	0.366	0.377	2	
72-0011	SEA WATER	O_2	mol m^{-3}	1	24	24	Knudsen bottle	NS	AT	NS	NS	0.29 - 0.41	0.35	0.35	2	
		SiO_3	mmol m^{-3}	1	22	21	Knudsen bottle	NS	S&P	NS	NS	0.30 - 10.00	4.09	2.45	2	
		PO_4	mmol m^{-3}	1	22	22	Knudsen bottle	NS	S&P	NS	NS	0.40 - 3.40	1.42	1.20	1,2	value over 1 are suspect
		NO_3+NO_2	mmol m^{-3}	1	22	20	Knudsen bottle	NS	S&P	NS	NS	0.16 - 4.19	2.12	1.52	2	
73-0128	SEA WATER	O_2	mol m^{-3}	2	12	12	Fiarie bottle	pickled; analysed < 24h	modified WT	± 0.02% to ± 0.8%	NS	0.227 - 0.482	0.296	0.267	1	
74-0016A	SEA WATER	Chl. a	mg m^{-3}	1	5	5	Knudsen bottle	filtered; frozen	spectrophotometry S&P	NS	NS	0.02 - 0.69	0.19	0.012	2	data presented graphically
		PO_4	mmol m^{-3}	1	5	5	Knudsen bottle	filtered; frozen with $CHCl_3$	S&P	NS	NS	0.77 - 1.60	1.11	1.00	2	data presented graphically
		NO_3+NO_2	mmol m^{-3}	1	5	5	Knudsen bottle	filtered; frozen with $CHCl_3$	S&P	NS	NS	1.0 - 12.0	5.76	1.60	2	data presented graphically
	SEA ICE (ice core)	Chl. a	mg m^{-2}	2	NS	NS	SIPRE corer	melted; filtered; frozen	spectrophotometry S&P	NS	NS	8.02 - 12.17	10.10	10.10	2	data presented as means; Note 1
		Chl. b	mg m^{-2}	2	NS	NS	SIPRE corer	melted; filtered; frozen	spectrophotometry S&P	NS	NS	1.47 - 1.75	1.61	1.61	2	data presented as means; Note 1
		Chl. c	mg m^{-2}	2	NS	NS	SIPRE corer	melted; filtered; frozen	spectrophotometry S&P	NS	NS	7.19 - 11.68	9.44	9.44	2	data presented as means; Note 1
		Phaeo.	mg m^{-2}	2	NS	NS	SIPRE corer	melted; filtered; frozen	spectrophotometry S&P	NS	NS	2.77 - 5.59	4.18	4.18	2	data presented as means; Note 1
		Chl. a	mg m^{-3}	1	9	9	SIPRE corer	melted; filtered; frozen	spectrophotometry	NS	NS	0.04 - 41.0	4.61	0.06	2	data presented graphically
		PO_4	mmol m^{-3}	1	9	9	SIPRE corer	melted; filtered; frozen with $CHCl_3$	S&P	NS	NS	0.02 - 0.26	0.10	0.08	2	data presented graphically
		NO_3+NO_2	mmol m^{-3}	1	9	9	SIPRE corer	melted; filtered; frozen with $CHCl_3$	S&P	NS	NS	0.32 - 1.30	0.56	0.46	2	data presented graphically
74-0021	SEA ICE (ice core)	Chl. a	mg m^{-3}	1	9	9	SIPRE corer	melted; $MgCO_3$ added; 0.45 µm filtered; frozen; in dark	FS	NS	NS	0.01 - 60.11	6.76	0.03	2	
		Phaeo.	mg m^{-3}	1	9	9	SIPRE corer	melted; $MgCO_3$ added; 0.45 µm filtered; frozen; in dark	FS	NS	NS	0.01 - 27.60	3.18	0.02	2	
		NO_3	mmol m^{-3}	1	9	9	SIPRE corer	frozen opaque plastic bottles	spectrophotometry S&P	NS	NS	1.08 - 3.01	2.09	2.42	2	
74-0118	SEA WATER	O_2	mol m^{-3}	10	10	10	NS	NS	S&P	NS	NS	0.41 - 0.46	0.44	0.43	2	
		pH	pH units	10	10	10	NS	NS	pH meter	NS	NS	6.70 - 7.90	NC	7.90	2	

DATA SET NO.	MEDIUM SAMPLED	MEASUREMENT		NO. STATIONS	NO. SAMPLES	NO. SAMPLES w.l.	METHODOLOGY		INFORMATION			MEASURED VALUES			DATA RATING	REMARKS
		Qty	Units				Collection	Storage	Analysis	Precision	Accuracy	Range	Mean	Median		
76-0121	SEA WATER	O_2	mol m^{-3}	1	6	6	NA	NA	Winkler-Whitney Water Analyzer	NS	NS	0.336 - 0.388	0.373	0.376	2	Note 2
		pH	-	1	6	6	NA	NA	Winkler-Whitney Water Analyzer	NS	NS	8.69 - 8.70	NC	8.67	2	Note 2
		As	µmol m^{-3}	2	11	10	Niskin bottle	acidified (acid not specified)	dry ashing; AgDDC extraction; colorimetry	NS	NS	< 13.3 - 17.4	NC	NC	2	± 2.67
		Cd	µmol m^{-3}	2	11	0	Niskin bottle	filtered .45µm; acidified (acid not specified)	APDC extraction; FAAS	NS	NS	< 8.9	NC	NC	0	Note 1
		Cu	µmol m^{-3}	2	11	11	Niskin bottle	filtered .45µm; acidified (acid not specified)	APDC extraction; FAAS	NS	NS	16 - 31	20	16	2	
		Fe	µmol m^{-3}	2	11	0	Niskin bottle	filtered .45µm; acidified (acid not specified)	APDC extraction; FAAS	NS	NS	< 900	NC	NC	0	Note 1
		Pb	µmol m^{-3}	2	11	3	Niskin bottle	filtered .45µm; acidified (acid not specified)	APDC extraction; FAAS	NS	NS	< 9.7 - 14	NC	NC	0	Note 1
		Zn	µmol m^{-3}	2	11	11	Niskin bottle	filtered .45µm; acidified (acid not specified)	APDC extraction; FAAS	NS	NS	31 - 157	96	61	0	Note 1
	BOTTOM SEDIMENT	Cd	µmol kg^{-1}	5	5	5	plastic 10 cm x 5 cm diam. corer by diver	frozen	HNO_3 digestion -100 mesh fraction	NS	NS	< 2.3 - 9.4	6	5	2	DWB
		Cu	µmol kg^{-1}	5	5	5	plastic 10 cm x 5 cm diam. corer by diver	frozen	HNO_3 digestion -100 mesh fraction	NS	NS	118 - 218	192	198	2	DWB
		Fe	mmol kg^{-1}	5	5	5	plastic 10 cm x 5 cm diam. corer by diver	frozen	HNO_3 digestion -100 mesh fraction	NS	NS	102 - 177	146	148	2	DWB
		Pb	µmol kg^{-1}	5	5	5	plastic 10 cm x 5 cm diam. corer by diver	frozen	HNO_3 digestion -100 mesh fraction	NS	NS	59 - 167	79	59	2	DWB
		Zn	µmol kg^{-1}	5	5	5	plastic 10 cm x 5 cm diam. corer by diver	frozen	HNO_3 digestion -100 mesh fraction	NS	NS	389 - 1640	877	692	2	DWB
	BIOTA (Mya truncata soft parts)	Cd	µmol kg^{-1}	2	2	2	by hand using SCUBA	frozen	homogenized; HNO_3 digest; FAAS	NS	NS	35.9 - 40.4	38.2	38.2	2	20 or 21 organisms pooled for sample; DWB
		Cu	µmol kg^{-1}	2	2	2	by hand using SCUBA	frozen	homogenized; HNO_3 digest; FAAS	NS	NS	152 - 172	162	162	2	20 or 21 organisms pooled for sample; DWB
		Fe	mmol kg^{-1}	2	2	2	by hand using SCUBA	frozen	homogenized; HNO_3 digest; FAAS	NS	NS	2.81 - 4.87	3.84	3.84	2	20 or 21 organisms pooled for sample; DWB

DATA SET NO.	MEDIUM SAMPLED	MEASUREMENT		NO. STATIONS	NO. SAMPLES	NO. SAMPLES m.i.	METHODOLOGY		INFORMATION			MEASURED VALUES			DATA RATING	REMARKS
		Qty	Units				Collection	Storage	Analysis	Precision	Accuracy	Range	Mean	Median		
79-0121, (cont'd)	BIOTA	Pb	umol kg-1	2	2	1	by hand using SCUBA	frozen	homogenized; HNO_3 digest; FAAS	NS	NS	< 22 - 57.9	NC	NC	2	20 or 21 organisms pooled for sample; DWB
		Zn	mmol kg-1	2	2	2	by hand using SCUBA	frozen	homogenized; HNO_3 digest; FAAS	NS	NS	1.78 - 2.32	2.18	2.18	2	20 or 21 organisms pooled for sample; DWB
	Mya truncata (periostracum)	Cd	umol kg-1	2	2	2	by hand using SCUBA	frozen	homogenized; HNO_3 digest; FAAS	NS	NS	11.3 - 28.3	19.8	19.8	2	20 or 21 organisms pooled per sample; DWB
		Cu	umol kg-1	2	2	2	by hand using SCUBA	frozen	homogenized; HNO_3 digest; FAAS	NS	NS	261 - 441	351	351	2	20 or 21 organisms pooled per sample; DWB
		Fe	mmol kg-1	2	2	2	by hand using SCUBA	frozen	homogenized; HNO_3 digest; FAAS	NS	NS	325 - 657	491	491	2	20 or 21 organisms pooled per sample; DWB
		Pb	umol kg-1	2	2	2	by hand using SCUBA	frozen	homogenized; HNO_3 digest; FAAS	NS	NS	177 - 1290	710	710	2	20 or 21 organisms pooled per sample; DWB
		Zn	mmol kg-1	2	2	2	by hand using SCUBA	frozen	homogenized; HNO_3 digest; FAAS	NS	NS	1.09 - 5.43	3.27	3.27	2	20 or 21 organisms pooled per sample; DWB
	(Buccinum tottenii soft parts)	Cd	umol kg-1	2	2	2	by hand using SCUBA	frozen	homogenized; HNO_3 digest; FAAS	NS	NS	19.7 - 131.7	75.7	75.7	2	18 organisms pooled per sample; DWB
		Cu	umol kg-1	2	2	2	by hand using SCUBA	frozen	homogenized; HNO_3 digest; FAAS	NS	NS	129 - 227	175	175	2	18 organisms pooled per sample; DWB
		Fe	mmol kg-1	2	2	2	by hand using SCUBA	frozen	homogenized; HNO_3 digest; FAAS	NS	NS	4.33 - 10.1	7.23	7.23	2	18 organisms pooled per sample; DWB
		Pb	umol kg-1	2	2	0	by hand using SCUBA	frozen	homogenized; HNO_3 digest; FAAS	NS	NS	< 19	NC	NC	1	18 organisms pooled per sample; DWB
		Zn	mmol kg-1	2	2	2	by hand using SCUBA	frozen	homogenized; HNO_3 digest; FAAS	NS	NS	1.66 - 8.00	4.82	4.82	2	3 organisms pooled per sample; DWB
	(Serripes groenlandicus soft parts)	Cd	umol kg-1	1	1	1	by hand using SCUBA	frozen	homogenized; HNO_3 digest; FAAS	NS	NS	NC	17.8	NC	2	3 organisms pooled per sample; DWB
		Cu	umol kg-1	1	1	1	by hand using SCUBA	frozen	homogenized; HNO_3 digest; FAAS	NS	NS	NC	119	NC	2	3 organisms pooled per sample; DWB
		Fe	mmol kg-1	1	1	1	by hand using SCUBA	frozen	homogenized; HNO_3 digest; FAAS	NS	NS	NC	9.89	NC	2	3 organisms pooled per sample; DWB
		Pb	umol kg-1	1	1	1	by hand using SCUBA	frozen	homogenized; HNO_3 digest; FAAS	NS	NS	NC	1170	NC	2	3 organisms pooled per sample; DWB
		Zn	mmol kg-1	1	1	1	by hand using SCUBA	frozen	homogenized; HNO_3 digest; FAAS	NS	NS	NC	1.41	NC	2	3 organisms pooled per sample; DWB
79-0137	SEA WATER	O_2	$ml\ m^{-3}$	1	9	1	Fjarlie bottle	analysis < 24h	Hach OX-2P DO kit	± 2%	NS	0.219 - 0.35	0.24	0.29	1	
79-0138	SEA WATER	O_2	$ml\ m^{-3}$	1	6	6	Fjarlie bottle	analysis < 24h	Hach OX-2P DO kit	± 2%	NS	0.131 - 0.372	0.219	0.175	1	

DATA SET NO.	MEDIUM SAMPLED	MEASUREMENT		NO. STATIONS	NO. SAMPLES	NO. SAMPLES rd.l.	METHODOLOGY		INFORMATION			MEASURED VALUES			DATA RATING	REMARKS
		Qty	Units				Collection	Storage	Analysis	Precision	Accuracy	Range	Mean	Median		
76-0010	SEA WATER	CHL a	mg m-3	23	88	88	PVC Niskin bottle	stored < 8 h opaque poly bottles; $MgCO_3$ added; 0.45 µm filtered; frozen with silica gel	S&P	NS	NS	0.04 - 9.51	3.24	2.73	2	Note 4
		NO_3	mmol m-3	9	35	35	PVC Niskin bottle	stored < 8 h opaque poly bottles; 0.45 µm filtered; frozen in opaque poly bottles	S&P	NS	NS	0.09 - 9.56	3.14	2.04	2	Note 4
		PO_4	mmol m-3	9	35	35	PVC Niskin bottle	stored < 8 h opaque poly bottles; 0.45 µm filtered; frozen in opaque poly bottles	S&P	NS	NS	0.48 - 1.19	0.78	0.75	2	Note 4
		SiO_3	mmol m-3	9	35	35	PVC Niskin bottle	stored < 8 hr opaque poly bottles; 0.45 µm filtered; frozen in opaque poly bottles	S&P	NS	NS	0.20 - 15.24	4.77	5.70	2	Note 4
76-0117	SEA WATER	O_2	mol m-3	1	7	7	Fjarlie bottle	analysis < 24h	Hach OX-2P DO kit	± 2%	NS	0.20 - 0.413	0.275	0.266	1	
77-0014	BOTTOM SEDIMENT (< 2mm)	OC	%	6	6	6	Van Veen grab	refrigerated or frozen in plastic bags	oven-dried; rewetted; sieved; wet-oxidation with H_2SO_4	NS	NS	1.72 - 2.59	2.14	2.16	2	DWB
		CO_2	mol kg-1	6	6	6	Van Veen grab	refrigerated or frozen in plastic bags	oven-dried; rewetted; sieved; HCl (4N) digest with $CaCO_3$ standard and FAAS	NS	NS	2.28 - 3.00	2.60	2.56	2	DWB
		Si	mol kg-1	5	5	5	Van Veen grab	refrigerated or frozen in plastic bags	oven-dried; rewetted; sieved; HF digestion; FAAS	NS	NS	7.33 - 7.83	7.60	7.62	2	DWB
		Al	mol kg-1	5	5	5	Van Veen grab	refrigerated or frozen in plastic bags	oven-dried; rewetted; sieved; HF digestion; FAAS	NS	NS	1.11 - 2.19	1.83	1.89	2	DWB
		Ti	mol kg-1	5	5	5	Van Veen grab	refrigerated or frozen in plastic bags	oven-dried; rewetted; sieved; HF digestion; FAAS	NS	NS	0.03 - 0.07	0.06	0.06	2	DWB
		Fe	mol kg-1	5	5	5	Van Veen grab	refrigerated or frozen in plastic bags	oven-dried; rewetted; sieved; HF digestion; FAAS	NS	NS	0.29 - 0.70	0.54	0.58	2	DWB
		Ca	mol kg-1	6	6	6	Van Veen grab	refrigerated or frozen in plastic bags	oven-dried; rewetted; sieved; HF digestion; FAAS	NS	NS	0.003 - 0.30	0.008	0.003	2	DWB
		Mg	mol kg-1	5	5	5	Van Veen grab	refrigerated or frozen in plastic bags	oven-dried; rewetted; sieved; HF digestion; FAAS	NS	NS	1.33 - 2.27	1.63	1.53	2	DWB
		Pb	µmol kg-1	5	5	5	Van Veen grab	refrigerated or frozen in plastic bags	oven-dried; rewetted; sieved; CH_3COOH digestion; FAAS	± 19%	NS	48.3 - 77.3	64.7	67.6	1	DWB; USGS-MAG-1
		Li	µmol kg-1	5	5	5	Van Veen grab	refrigerated or frozen in plastic bags	oven-dried; rewetted; sieved; HF digestion; FAAS	NS	NS	7.34 - 10.66	8.93	8.90	2	DWB

DATA SET NO.	MEDIUM SAMPLED	MEASUREMENT		NO. STATIONS	NO. SAMPLES	NO. SAMPLES ≠0	METHODOLOGY		INFORMATION			MEASURED VALUES			DATA RATING	REMARKS
		Qty	Units				Collection	Storage	Analysis	Precision	Accuracy	Range	Mean	Median		
77-0016 (cont'd.)		Hg	µmol kg-1	5	5	5	Van Veen grab	refrigerated or frozen in plastic bags	oven-dried; rewetted; sieved; HF digestion; CVAAS	NS	NS	0.1 - 0.25	0.19	0.25	2	D&R
		Mn	mmol kg-1	5	5	5	Van Veen grab	refrigerated or frozen in plastic bags	oven-dried; rewetted; sieved; HF digestion; FAAS	NS	NS	2.7 - 12.0	7.7	9.1	2	D&R
		Zn	mmol kg-1	5	5	5	Van Veen grab	refrigerated or frozen in plastic bags	oven-dried; rewetted; sieved; CH_3COOH digestion; FAAS	± 2%	NS	0.63 - 1.25	0.98	0.98	1	D&R; USGS-MAG-1
		Cu	mmol kg-1	5	5	5	Van Veen grab	refrigerated or frozen in plastic bags	oven-dried; rewetted; sieved; CH_3COOH digestion; FAAS	± 15%	NS	0.31 - 0.66	0.50	0.50	1	D&R; USGS-MAG-1
		Co	mmol kg-1	5	5	5	Van Veen grab	refrigerated or frozen in plastic bags	oven-dried; rewetted; sieved; CH_3COOH digestion; FAAS	± 10%	NS	0.14 - 0.26	0.20	0.22	1	D&R; USGS-MAG-1
		Ni	mmol kg-1	5	5	5	Van Veen grab	refrigerated or frozen in plastic bags	oven-dried; rewetted; sieved; CH_3COOH digestion; FAAS	± 7%	NS	0.24 - 0.58	0.41	0.43	1	D&R; USGS-MAG-1
		Cr	mmol kg-1	5	5	5	Van Veen grab	refrigerated or frozen in plastic bags	oven-dried; rewetted; sieved; CH_3COOH digestion; FAAS	± 2%	NS	0.75 - 1.69	1.22	1.27	1	D&R; USGS-MAG-1
		V	mmol kg-1	5	5	5	Van Veen grab	refrigerated or frozen in plastic bags	oven-dried; rewetted; sieved; CH_3COOH digestion; FAAS	± 5%	NS	0.94 - 1.85	1.32	1.32	1	D&R; USGS-MAG-1
		Cd	µmol kg-1	5	5	5	Van Veen grab	refrigerated or frozen in plastic bags	oven-dried; rewetted; sieved; CH_3COOH digestion;GFAAS	± 5%	NS	0.59 - 2.77	1.70	1.57	1	D&R; USGS-MAG-1
	BOTTOM SEDIMENT (whole)	Oil	mg kg-1	5	5	5	Shipek grab	frozen in glass jars	freeze dried; hexane extraction; FS	NS	NS	2.50 - 10.00	6.00	5.00	2	
	SEA WATER (floating residue)	Particulate oil	µg m-2	6	6	0	Sameoto box Neuston net	frozen in glass jars	CCl_4 extraction; gravimetry	NS	NS	< 0.5	< 0.5	< 0.5	1	
	SEA WATER (water column)	Oil	mg m-1	6	76	736	CTD/rosette package with Niskin samplers	immediate CCl_4 extraction; storage of extracts till analysis	FS	NS	NS	<0.1 - 2.8	0.51	0.40	2	
		O_2	mol m-3	6	77	77	Niskin bottles on CTD/rosette	NS	NS	± 0.4%	NS	0.24 - 0.41	0.33	0.3	2	
		CH_4	mmol m-3	6	71	71	glass lined Niumer sampler	CCl_4 extraction immediately with custom apparatus; storage NS	CCl_4 extraction; GCFID	NS	NS	0.67 - 18.03	7.20	7.19	2	
		alk_T	equiv m-3	6	71	71	NS	NS	NS	NS	NS	2.071 - 2.617	2.231	2.234	2	Note 5
		CO_T	equiv m-3	6	71	71	NS	NS	NS	NS	NS	1.840 - 2.530	2.103	2.124	2	
		SiO_3	mmol m-3	6	81	81	Niskin bottles on CTD/rosette	none; analysis within hours of collection	AuA	NS	NS	1.12 - 14.18	13.08	13.60	1	Note 6
		PO_4	mmol m-3	6	81	81	Niskin bottles on CTD/rosette	none; analysis within hours of collection	AuA	NS	NS	0.87 - 1.86	1.69	1.74	1	Note 6

DATA SET NO.	MEDIUM SAMPLED	MEASUREMENT		NO. STATIONS	NO. SAMPLES	NO. SAMPLES >d.l.	METHODOLOGY		INFORMATION			MEASURED VALUES			DATA RATING	REMARKS
		Qty	Units				Collection	Storage	Analysis	Precision	Accuracy	Range	Mean	Median		
77-0016 (cont'd.)		NO_3	mmol m^{-3}	6	81	74	Niskin bottles on CTD/rosette	none; analysis within hours of collection	AuA	NS	NS	<d.l. - 15.91	9.07	9.93	1	Note 6
		NH_3	mmol m^{-3}	1	1	1	Niskin bottles on CTD/rosette	NS	wet chemical oxidation; spectro-photometry at 640 nm	NS	NS	0.69 - 1.26	0.76	0.92	1	Note 6
		CN, a	mg m^{-3}	6	24	24	Niskin bottles on CTD/rosette	NS	FS; Yentsch and and Menzel (1963)	NS	NS	0.07 - 6.86	0.97	0.43	2	
		$\delta^{18}O$	o/oo	6	19	19	Niskin bottle	tightly capped glass bottles	Epstein and Mayeda (1953)	NS	NS	-2.37 - -0.27	-1.346	-1.44	2	relative to SMOW
		δ^3He	%	6	7	7	Go-Flo sampler	sealed copper tube; vacuum extraction 6 months storage	MS	NS	NS	11.9 - 14.7	23.01	22.1	2	standard not specified; Note 7
		He	umol m^{-3}	6	7	7	Go-Flo sampler	sealed copper tube; vacuum extraction 6 months storage	MS	± 0.5%	NS	1.90 - 1.95	1.92	1.91	1	
		Ne	umol m^{-3}	6	6	6	Go-Flo sampler	sealed copper tube; vacuum extraction 6 months storage	MS	± 0.3%	NS	8.55 - 8.72	8.65	8.65	1	
		^3H	T.U.	6	7	7	Go-Flo sampler	sealed copper tube; vacuum extraction 6 months storage	MS	±3%-±8%	NS	8.5 - 25.7	15.64	16.10	1	precision varies with concentration
		Mn	umol m^{-3}	2	6	6	Go-Flo sampler	acidified with Aristar to pH2; stored in acid cleaned PE bottles	MIBK extraction; (pH6) GFAAS	NS	NS	4.0 - 10.2	6.79	6.75	2	
		Fe	umol m^{-3}	2	6	6	Go-Flo sampler	acidified with Aristar to pH2; stored in acid cleaned PE bottles	MIBK extraction; (pH6) GFAAS	NS	NS	18.81 - 47.28	30.09	30.36	2	
		Ni	umol m^{-3}	2	6	6	Go-Flo sampler	acidified with Aristar to pH2; stored in acid cleaned PE bottles	MIBK extraction; (pH6) GFAAS	± 13%	NS	4.60 - 10.90	5.79	6.77	1	
		Cu	umol m^{-3}	2	6	6	Go-Flo sampler	acidified with Aristar to pH2; stored in acid cleaned PE bottles	MIBK extraction; (pH6) GFAAS	± 14%	NS	3.96 - 5.19	4.51	4.57	1	
		Cd	umol m^{-3}	2	6	6	Go-Flo sampler	acidified with Aristar to pH2; stored in acid cleaned PE bottles	MIBK extraction; (pH6) GFAAS	± 18%	NS	0.18 - 0.67	0.49	0.55	1	
77-0017	SEA WATER	PO_4	mmol m^{-3}	9	71	71	Knudsen bottle	glass tubes; frozen -40oC	AuA	± 0.01	± 0.03	0.38 - 1.79	1.14	1.17	4	
		NO_3	mmol m^{-3}	9	74	74	Knudsen bottle	glass tubes; frozen -40oC	AuA	± 0.01	± 0.5	0.1 - 18.0	7.8	9.9	4	
		SiO_3	mmol m^{-3}	9	74	74	Knudsen bottle	plastic tubes; frozen -40oC	AuA	± 0.02	± 0.25	5.4 - 29.9	13.6	12.2	4	

DATA SET NO.	MEDIUM SAMPLED	MEASUREMENT		NO. STATIONS	NO. SAMPLES	NO. SAMPLES ndl.	METHODOLOGY		INFORMATION			MEASURED VALUES			DATA RATING	REMARKS
		Qty	Units				Collection	Storage	Analysis	Precision	Accuracy	Range	Mean	Median		
77-0117 (cont'd.)		^3H	T.U.	8	47	47	Knudsen bottle	polyethylene wide mouth jars	NS	± 1	± 10	-9 - 75	33	35	2	analysis at Chalk River
		^2H	o/oo	8	48	48	Knudsen bottle	polyethylene wide mouth jars	NS	± 0.1	± 0.3	-99 - -1.7	-21.8	-21.0	2	analysis at Chalk River
		O_2	mol m^{-3}	10	85	85	Knudsen bottle	volumetric flasks 2 h to 2 day storage	micro WT	±3.12x10-4	±8.92x10-4	0.156 - 0.630	0.35	0.38	4	high O_2 values all from 2 m samples
82-0106	SEA WATER	SiO_3	mmol m^{-3}	3	8	8	Knudsen bottle	plastic tubes; frozen	AuA	± 9.3%	NS	19.1 - 23.1	18.3	18.1	3	precision as RMS deviation
		NO_3	mmol m^{-3}	3	8	8	Knudsen bottle	glass tubes; frozen	AuA	± 5.4%	NS	6.0 - 10.3	7.9	7.6	3	precision as RMS deviation
		PO_4	mmol m^{-3}	3	8	8	Knuden bottle	glass tubes; frozen	AuA	± 11.4%	NS	1.21 - 1.76	1.51	1.49	3	precision as RMS deviation
82-0107	SEA WATER	NO_3+NO_2	mmol m^{-3}	2	12	12	evacuated glass sphere at depth	frozen in plastic bottles	AuA S&P	NS	NS	5.21 - 10.29	7.56	6.90	2	Note 8
		PO_4	mmol m^{-3}	2	12	12	evacuated glass sphere at depth	frozen in plastic bottles	AuA S&P	NS	NS	1.05 - 1.52	1.39	1.40	2	Note 8
		SiO_3	mmol m^{-3}	2	12	12	evacuated glass sphere at depth	frozen in plastic bottles	AuA S&P	NS	NS	15.79 - 26.11	21.61	21.60	2	Note 8
82-0108	BOTTOM SEDIMENT (200 mesh grain size fraction)	Zn	umol kg-1	13	77	77	gravity corer; extruded; measured; sectioned	frozen in Whirlpaks	HF digestion; FAAS	2% - 29%	-7.7%- -2%	0.52 - 1.73	0.88	0.80	4	precision in RSD
		Cd	umol kg-1	13	77	77	gravity corer; extruded; measured; sectioned	frozen in Whirlpaks	HF digestion; GFAAS	11% - 23%	-8.6%- -9.9%	1.21 - 11.3	3.02	2.68	4	precision in RSD
		Pb	umol kg-1	13	77	77	gravity corer; extruded; measured; sectioned	frozen in Whirlpaks	HF digestion; GFAAS	7% - 25%	-33%- -29%	8.0 - 2690	121.22	80.0	3	precision in RSD
83-0056	SEA WATER	SiO_3	mmol m^{-3}	7	32	32	Knudsen reversing bottle	plastic tubes; frozen	AuA	± 12%	NS	8.3 - 35.6	23.3	25.2	3	precision as RMS deviation
		NO_3	mmol m^{-3}	7	32	32	Knudsen reversing bottle	glass tubes; frozen	AuA	± 10%	NS	2.5 - 18.7	12.5	13.7	3	precision as RMS deviation
		PO_4	mmol m^{-3}	7	32	32	Knudsen reversing bottle	glass tubes; frozen	AuA	± 16.3%	NS	1.01 - 2.02	1.53	1.58	3	precision as RMS deviation

DATA SET NO.	MEDIUM SAMPLED	MEASUREMENT		NO. STATIONS	NO. SAMPLES	NO. SAMPLES >d.l.	METHODOLOGY		INFORMATION			MEASURED VALUES			DATA RATING	REMARKS
		Qty	Units				Collection	Storage	Analysis	Precision	Accuracy	Range	Mean	Median		
83-0057	SEA WATER	Chl a.	mg m-3	13	102	102	modified continuous pump sampler	immediate analysis	FS; Holm-Hansen et al. (1965) method	NS	NS	0.08 26.93	2.89	0.58	2	
		C	mg m-3	13	100	100	modified continuous pump sampler	frozen, -20oC	CHN analyser	NS	NS	33 1165	277	132	2	
		N	mg m-3	13	76	76	modified continuous pump sampler	frozen, -20oC	CHN analyser	NS	NS	10 173	45	32.50	2	
		PO_4	mmol m^{-3}	13	102	102	modified continuous pump sampler	immediate analysis	AuA; method 155-71W	NS	NS	0.51 3.72	1.90	1.48	3	Note 6
		NO_3	mmol m^{-3}	13	102	95	modified continuous pump sampler	immediate analysis	AuA; method 158-71W	NS	NS	0.00 19.05	8.75	9.52	3	Note 6
		SiO_3	mmol m^{-3}	13	102	101	modified continuous pump sampler	immediate analysis	AuA; method 186-72W	NS	NS	-0.14 39.32	17.36	18.83	3	Note 6
		ATP	mg m-3	12	89	89	modified continuous pump sampler	immediate analysis	luciferin luciferase method	NS	NS	0.03 1.49	0.23	0.09	2	
	SEA WATER	Chl a.	mg m-3	5	5	5	modified continuous pump sampler	immediate analysis	FS; Holm-Hansen et al. method	NS	NS	5.61 12.17	8.41	7.77	2	
		PO_4	mmol m^{-3}	5	5	5	modified continuous pump sampler	immediate analysis	AuA; method 155-71W	NS	NS	0.53 1.05	0.90	1.04	3	Note 6
		NO_3	mmol m^{-3}	5	5	4	modified continuous pump sampler	immediate analysis	AuA; method 158-71W	NS	NS	0.00 3.82	1.03	0.11	3	Note 6
		SiO_3	mmol m^{-3}	5	5	5	modified continuous pump sampler	immediate analysis	AuA; method 186-72W	NS	NS	1.01 15.78	4.94	2.90	3	Note 6
		ATP	mg m-3	5	5	5	modified continuous pump sampler	immediate analysis	luciferin luciferase method	NS	NS	0.22 0.75	0.51	0.55	2	
	SEA WATER	Chl a.	mg m-3	5	5	5	modified continuous pump sampler	immediate analysis	FS; Holm-Hansen et al. (1965) method	NS	NS	0.09 1.26	0.60	0.57	2	
		C	mg m-3	5	5	5	modified continuous pump sampler	frozen, -20oC	CHN analyser	NS	NS	73 126	107	113	2	
		N	mg m-3	4	4	4	modified continuous pump sampler	frozen, -20oC	CHN analyser	NS	NS	3 23	13	13	2	
		PO_4	mmol m^{-3}	5	5	5	modified continuous pump sampler cont'd.	immediate analysis	AuA; method 155-71W	NS	NS	0.53 1.05	0.90	1.04	3	Note 6
		NO_3	mmol m^{-3}	5	5	4	modified continuous pump sampler	immediate analysis	AuA; method 158-71W	NS	NS	0.00 3.82	1.03	0.11	3	Note 6
		SiO_3	mmol m^{-3}	5	5	5	modified continuous pump sampler	immediate analysis	AuA; method 186-72W	NS	NS	1.01 15.78	4.94	2.90	3	Note 6
		ATP	mg m-3	5	5	5	modified continuous pump sampler	immediate analysis	luciferin luciferase method	NS	NS	0.05 0.07	0.06	0.06	2	
83-0015	SEA WATER	Si	umol m-3	1	12	12	NS	NS	NS	NS	NS	14.15 - 25.47	18.10	16.18	2	
		NO_3	umol m^{-3}	1	12	12	NS	NS	NS	NS	NS	4.91 - 12.88	9.26	8.31	2	

10. DATA INVENTORY TABLE 3.

LISTING OF MEASUREMENT LOCATIONS

Description of Table 3 Headings

Table 3 provides specific spatial and temporal details for collected samples. These include:

(1) station position (latitude, longitude). For stations where no latitude/longitude are expressed, estimates were made by direct measurement of the plotted station points contained in individual original reports;

(2) station depth;

(3) sampling time (year, month, day and hour in GMT or local time);

(4) number of points (samples in profiles); and

(5) maximum depth sampled.

DATA SET NUMBER	STATION NUMBER	LATITUDE °N	LONGITUDE °W	STATION DEPTH (m)	TIME SAMPLED				NUMBER POINTS	MAXIMUM DEPTH SAMPLED (m)	REMARKS
					YEAR	MONTH	DAY	HOUR GMT			
52-0003	43	79° 59'	85° 57'	64	52	August	17	17.0	6	50	
	44	79° 54'	86° 38'	347	52	August	18	15.0	11	300	
	45	79° 01'	85° 28'	118	52	August	18	21.0	10	97	
	46	78° 25'	88° 10'	329	52	August	18	3.0	13	145	
	47	77° 47'	89° 22'	310	52	August	19	6.0	11	300	
	48	76° 59'	89° 30'	292	52	August	19	11.0	10	250	
	49	76° 18'	88° 46'	182	52	August	19	16.0	8	150	
	50	75° 57'	81° 12'	529	52	August	20	1.0	18	476	
60-0066	1	78° 44.5'	103° 30'	184	60	April	18	NS	2	180	
	8	79° 09.5'	106° 35'	458	60	May	4	NS	11	450	
61-0009	1	78° 28'	105° 16'	477	61	April	13	22.1	15	456	
	2	78° 47'	105° 31'	298	61	April	25	20.4	14	300	
	3	78° 35'	105° 28'	402	61	April	30	2.4	15	425	
	4	78° 28'	105° 16'	477	61	May	3	21.1	15	462	
61-0078	1	75° 45'	84° 35'	80	61	November	13	NS	5	80	
	2	75° 45'	84° 35'	80	61	November	27	NS	5	78	
	3	75° 45'	84° 35'	80	61	December	24	NS	5	78	
	4	75° 45'	84° 35'	80	62	January	9	NS	5	80	
	5	75° 45'	84° 35'	80	62	January	21	NS	5	80	
	6	75° 45'	84° 35'	80	62	February	3	NS	5	80	
	7	75° 45'	84° 35'	80	62	February	18	NS	5	80	
	8	75° 45'	84° 35'	80	62	March	5	NS	5	80	
	9	75° 45'	84° 35'	80	62	March	3	NS	5	80	
	10	75° 45'	84° 35'	80	62	April	2	NS	5	80	
	11	75° 45'	84° 35'	80	62	April	16	NS	5	80	
	12	75° 45'	84° 35'	80	62	May	1	NS	5	80	
	13	75° 45'	84° 35'	80	62	May	26	NS	5	80	
	14	75° 45'	84° 35'	80	62	June	12	NS	5	80	
	15	75° 45'	84° 35'	80	62	June	29	NS	5	80	

DATA SET NUMBER	STATION NUMBER	LATITUDE °N	LONGITUDE °W	STATION DEPTH (m)	TIME SAMPLED YEAR	MONTH	DAY	HOUR GMT	NUMBER POINTS	MAXIMUM DEPTH SAMPLED (m)	REMARKS
62-0005	1	80° 00'	86° 00'	59	62	July	2	22.3	9	50	
	2	80° 00'	86° 00'	70	62	July	6	15.5	9	50	
	3	80° 00'	86° 00'	56	62	July	9	20.0	9	50	
	4	81° 03'	91° 25'	29	62	July	11	6.3	8	25	
	5	80° 00'	86° 00'	56	62	July	13	21.3	7	50	
	6	79° 10'	86° 00'	59	62	July	16	15.3	9	50	
	7	80° 00'	86° 00'	57	62	July	18	21.2	9	50	
	8	80° 00'	92° 00'	59	62	July	21	20.5	9	50	
	9	80° 00'	86° 00'	66	62	July	25	15.2	9	50	
	10	80° 00'	86° 00'	56	62	July	28	20.3	9	50	
	11	80° 00'	86° 00'	56	62	July	31	6.2	9	50	
	12	80° 00'	86° 00'	51	62	August	4	0.3	9	50	
	13	80° 00'	86° 00'	63	62	August	6	15.2	9	50	
	14	80° 00'	86° 00'	66	62	August	10	1.3	9	50	
	15	79° 55'	85° 20'	48	62	August	11	0.9	5	47	
	16	80° 00'	86° 00'	69	62	August	13	22.5	9	50	
	17	80° 00'	86° 00'	50	62	August	16	18.0	8	48	
62-0006	24	76° 01'	81° 23'	732	62	August	14	10.6	12	700	
	27	76° 05'	87° 00'	616	62	August	15	8.5	12	600	
	29	76° 23'	89° 22'	181	62	August	15	15.6	8	150	
	31	80° 25'	85° 00'	658	62	August	22	16.4	13	600	
	32	81° 00'	79° 00'	300	62	August	23	17.1	11	275	
	34	81° 13'	91° 15'	786	62	August	24	8.1	14	700	
	40	78° 09'	88° 08'	249	62	August	25	15.3	9	200	
	44	76° 53'	98° 24'	311	62	August	26	14.4	10	250	
	46	75° 25'	92° 46'	194	62	August	27	3.8	8	150	
	47	75° 23'	93° 26'	252	62	August	27	5.6	8	250	
	55	75° 22'	118° 05'	256	62	August	31	0.9	9	200	

DATA SET NUMBER	STATION NUMBER	LATITUDE o N	LONGITUDE o W	STATION DEPTH (m)	TIME SAMPLED				NUMBER POINTS	MAXIMUM DEPTH SAMPLED (m)	REMARKS
					YEAR	MONTH	DAY	HOUR GMT			
62-0066	1	79o 10'	92o 00'	NS	62	July	18	NS	9	50	
62-0067	1	79o 55'	85o 20'	NS	62	August	10	NS	6	47	
63-0057	44	76o 06'	81o 06'	237	63	September	24	NS	9	194	
	45	76o 01'	81o 10'	694	63	September	24	NS	13	593	
	46	75o 56'	81o 12'	657	63	September	24	NS	13	471	
	47	75o 53.5'	81o 10'	570	63	September	24	NS	13	425	
	48	76o 02'	82o 32'	639	63	September	24	NS	16	787	
	49	76o 15.5'	84o 02'	99	63	September	25	NS	6	75	
	50	76o 07.5'	84o 21'	121	63	September	25	NS	7	100	
	51	76o 05'	84o 12'	740	63	September	25	NS	14	708	
	52	75o 58'	84o 04'	641	63	September	25	NS	13	600	
	53	75o 52'	84o 00'	584	63	September	25	NS	14	569	
	54	75o 45'	87o 30'	142	63	September	25	NS	9	123	
	55	75o 49'	87o 23'	246	63	September	25	NS	9	191	
	56	76o 00'	87o 15'	480	63	September	25	NS	12	442	
	57	76o 10'	87o 08'	507	63	September	26	NS	13	439	
	58	76o 18'	87o 12'	103	63	September	26	NS	6	75	
	59	76o 19'	88o 52'	139	63	September	26	NS	7	85	
	60	76o 23'	88o 40'	173	63	September	26	NS	8	125	
	61	76o 08.5'	88o 38'	96	63	September	26	NS	6	75	

DATA SET NUMBER	STATION NUMBER	LATITUDE °N	LONGITUDE °W	STATION DEPTH (m)	TIME SAMPLED YEAR	MONTH	DAY	HOUR GMT	NUMBER POINTS	MAXIMUM DEPTH SAMPLED (m)	REMARKS
64-0054	1	78° 45'	104° 51'	224	64	February	3	1.1	NS	NS	41 samples collected over the 3 sampling days, times and depths not specified.
	2	78° 45'	104° 51	224	64	February	10	0.1	NS	NS	
	3	78° 45'	104° 51'	224	64	February	19	0.1	NS	NS	
64-0008	10	81° 24.1'	77° 17.0'	231	64	May	24	8.5	7	100	
	14	81° 24.1'	77° 17.0'	231	64	May	31	9.0	7	100	
	19	81° 24.1'	77° 17.0'	231	64	June	7	12.7	7	100	
	20	81° 24.1'	77° 17.0'	231	64	June	15	6.2	8	100	
	30	81° 24.1'	77° 17.0'	231	64	July	6	17.4	8	200	
	31	81° 22.6'	77° 04.8'	63	64	July	22	9.7	6	50	
	32	81° 26.1'	76° 59.7'	64	64	July	29	11.7	5	50	
	33	81° 24.0'	77° 13.4'	192	64	August	5	14.4	7	100	
	35	81° 25.8'	77° 02.4'	100	64	August	18	15.5	7	100	
	36	81° 25.3'	77° 00.6'	153	64	August	25	8.5	7	100	
68-0001	68-55-5	76° 07.1'	84° 54.0'	NS	68	August	16	16.7	13	700	Locations of stations illustrated in text do not correspond to coordinates reported.
	68-55-6	77° 28.0'	89° 13.0'	NS	68	August	18	17.0	12	300	
	68-55-7	76° 53.6'	89° 49.0'	NS	68	August	20	0.9	8	125	
	68-55-8	76° 23.5'	89° 12.5'	NS	68	August	20	8.5	7	114	
	68-55-19	74° 50.8'	92° 44.0'	NS	68	September	8	19.1	7	75	
	68-55-20	74° 45.0'	92° 44.0'	NS	68	September	10	16.4	8	100	
71-0107	1	77° 21.2'	81° 09.0'	157	71	September	2	NS	12	101	
72-0011	2	74° 44.5'	93° 14.0'	130	72	September	28	16.0	10	130	
	3	74° 45.0'	92° 44.0'	100	72	September	28	18.0	7	100	
	4	74° 46.0'	92° 10.0	60	72	September	28	19.5	7	60	
73-0128	716	80° 35.5'	79° 34.0'	NS	73	April	4	NS	6	500	Coordinates may be in error.
	748	80° 34.0'	80° 28.0'	NS	73	April	15	NS	6	500	

DATA SET NUMBER	STATION NUMBER	LATITUDE °N	LONGITUDE °W	STATION DEPTH (m)	TIME SAMPLED YEAR	MONTH	DAY	HOUR GMT	NUMBER POINTS	MAXIMUM DEPTH SAMPLED (m)	REMARKS
74-0014A	3	75° 32'	102° 50'	NS	74	May	NS	NS	1	SFC	Coordinates estimated from figure in text.
	2	75° 28'	103° 45'	NS	74	May	14	NS	14	75	
74-0023	3	75° 34'	102° 52'	NS	74	May	7-20	NS	9	SFC	
74-0118	1	78° 04.7'	100° 49.2'	85	74	August	14-28	NS	1	SFC	Coordinates estimated from figure in text.
	2	78° 04.1'	100° 46.9'	5.5	74	August	14-28	NS	1	SFC	
	3	78° 05.0'	100° 45.6'	2	74	August	14-28	NS	1	SFC	
	4	78° 05.3'	100° 49.2'	6.4	74	August	14-28	NS	1	SFC	
	5	78° 04.1'	100° 49.0'	16.8	74	August	14-28	NS	1	SFC	
	6	78° 03.9'	101° 02.3'	87	74	August	14-28	NS	1	SFC	
	7	78° 07.9'	100° 58.3'	26.5	74	August	14-28	NS	1	SFC	
	8	78° 10.2'	101° 02.8'	43	74	August	14-28	NS	1	SFC	
	9	78° 10.5'	101° 08.9'	27.5	74	August	14-28	NS	1	SFC	
	10	78° 01.6'	100° 49.7'	9.5	74	August	14-28	NS	1	SFC	
74-0121	CB-1	75° 23.1'	96° 53.8'	NS	74	August	19-21	NS	6	20	O_2 and pH; Coordinates estimated from figure.
	CB-1	75° 23.1'	96° 53.8'	NS	74	August	19-21	NS	5	17	metals; coordinates estimated from figure; text indicates that time and location of sampling are slightly different than the above.
	CB-2	75° 23.0'	96° 53.4'	NS	74	August	19-21	NS	6	27	Coordinates estimated from figure.

DATA SET NUMBER	STATION NUMBER	LATITUDE o N	LONGITUDE o W	STATION DEPTH (m)	TIME SAMPLED YEAR	MONTH	DAY	HOUR GMT	NUMBER POINTS	MAXIMUM DEPTH SAMPLED (m)	REMARKS
74-0121, cont'd.	DS-3	75o 22.9'	96o 54'	9	74	August	17	NS	1	Bottom	Coordinates estimated from figure; depth and location estimated by divers.
	DS-4	75o 22.9'	96o 55.8'	12	74	August	18	NS	1	Bottom	Coordinates estimated from figure; depth and location estimated by divers.
	DS-5	75o 23.2'	96o 53.2'	9	74	August	17	NS	1	Bottom	sediment; Coordinates estimated from figure; depth and location estimated by divers.
	DS-5	75o 23.2'	96o 53.2'	8	74	August	20	NS	2	Bottom	biota and sediment; Coordinates estimated from figure; depth and location estimated by divers.
	DS-7	75o 23.2'	96o 53.2'	8	74	August	21	NS	2	Bottom	biota and sediment; Coordinates estimated from figure; depth and location estimated by divers.

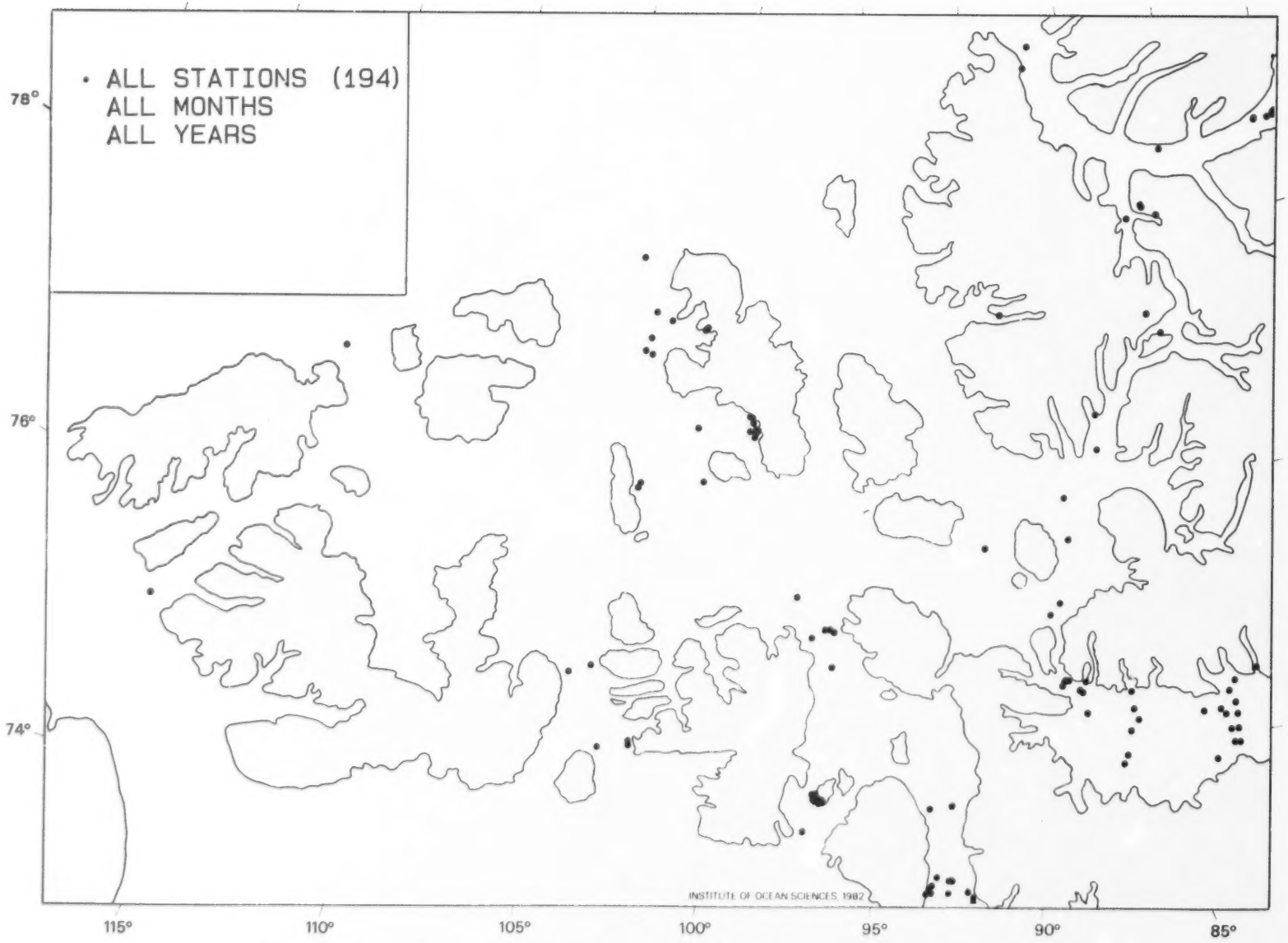
DATA SET NUMBER	STATION NUMBER	LATITUDE o N	LONGITUDE o W	STATION DEPTH (m)	TIME SAMPLED YEAR	MONTH	DAY	HOUR GMT	NUMBER POINTS	MAXIMUM DEPTH SAMPLED (m)	REMARKS
74-0121 cont'd.	DS-8	76o 23.3'	96o 56.8'	NS	74	August	22	NS	1	Bottom	biota; Coordinates estimated from figure; depth and location estimated by divers.
75-0137	8	80o 34.5'	79o 28'	534	75	April	11	NS	3	400	
75-0138	NS	80o 36'	79o 28'	NS	75	June	13	NS	6	400	estimated position (relative to arbitrary ref. point).
76-0010	1	74o 44'	93o 23.5'	16-19	76	June	2-14	NS	13	15	
	2	74o 46.2'	93o 18.5'	NS	76	June	6-14	NS	15	25	
	3	74o 48'	93o 13.5'	NS	76	June	9-12	NS	15	25	
	8	74o 50.8'	92o 38.0'	NS	76	June	25-29	NS	15	25	
	4	74o 43.5'	92o 00.0'	NS	76	June	25-29	NS	15	25	
	5	74o 41'	91o 59.5'	NS	76	June	21-22		15	25	
76-0018	76-1	80o 34.45'	79o 29'	495	76	March	12	NS	7	400	
77-0014	45	76o 21.1'	89o 25.8'	173	77	September	13	0.7	NS	173	
	46	76o 23.6'	89o 18.3'	197	77	September	13	2.5	NS	197	
	47	75o 51.8'	83o 49.9'	590	77	September	13	14.0	NS	590	
	48	75o 58.0'	83o 50.5'	658	77	September	13	14.7	NS	658	
	49	76o 04.7'	83o 49.9'	535	77	September	13	18.5	NS	535	
	50	76o 10.0'	83o 51.4	374	77	September	13	21.0	NS	374	
	51	76o 20.1'	83o 49.3'	120	77	September	14	0.2	NS	120	

DATA SET NUMBER	STATION NUMBER	LATITUDE °N	LONGITUDE °W	STATION DEPTH (m)	TIME SAMPLED YEAR	MONTH	DAY	HOUR GMT	NUMBER POINTS	MAXIMUM DEPTH SAMPLED (m)	REMARKS
77-0117	1	80° 34.8'	78° 12.5'	118	77	March	16	22.5	7	110	
	2	80° 35.7'	78° 23.8'	186	77	March	17	4.7	8	180	
	3	80° 36.0'	78° 30.0'	165	77	March	17	19.7	8	160	
	4	80° 35.0'	78° 38.0'	247	77	March	17	23.5	8	220	
	5	80° 33.5'	80° 30.0'	241	77	March	21	20.8	8	235	
	6	80° 33.7'	79° 51.8'	190	77	March	21	24.6	8	180	
	7	80° 35.3'	78° 53.8'	369	77	March	24	18.7	10	365	
	8	80° 34.8'	79° 09.5	480	77	March	24	22.8	10	470	
	9	80° 34.3'	79° 35.3	513	77	March	25	24.4	10	500	
	10	80° 34.7'	79° 22.5'	464	77	March	27	19.2	11	400	
82-0106	4109-A2	76° 39.9'	97° 19.2'	122	82	March	22	17.7	1	5	
	4112-B1	78° 00.5'	102° 55.9'	521	82	March	23	19.1	1	5	
	4115-B4	77° 27.6'	104° 31.6'	328	82	March	24	0.1	2	50	
	4118-C1	76° 03.7'	104° 33.2'	126	82	March	25	17.8	2	50	
	4121-C4	75° 58.3'	105° 11.0'	140	82	March	25	20.4	2	50	
82-0107	92	74° 52.0'	93° 06'	NS	82	April	8	NS	5	150	Sampling to near bottom.
	73	75° 07.2'	97° 12'	NS	82	April	10	NS	5	205	
82-0108	3	75° 22.3'	96° 59.9'	306	82	June	6	NS	5	Bottom	Positioning by dead reckoning and bathymetry.
	5	75° 22.4'	96° 54.1'	44	82	June	7	NS	5	Bottom	
	7	75° 21.6'	96° 57.4'	260	82	June	7	NS	15	Bottom	
	9	75° 21.9'	96° 52.6'	33	82	June	6	NS	5	Bottom	
	12	75° 20.8'	96° 49.2'	135	82	June	7	NS	5	Bottom	
	13	75° 22.0'	96° 45.8'	46	82	June	7	NS	5	Bottom	
	15	75° 22.4'	96° 44.3'	50	82	June	7	NS	7	Bottom	
	17	75° 22.0'	96° 42.9'	120	82	June	7	NS	6	Bottom	
	18	75° 23.1'	96° 59.9'	323	82	June	7	NS	5	Bottom	
	19	75° 23.5'	96° 58.3'	213	82	June	8	NS	5	Bottom	
	23	75° 24.6'	96° 59.6'	77	82	June	8	NS	5	Bottom	
	24	75° 24.8'	96° 57.3'	125	82	June	8	NS	5	Bottom	
	25	75° 24.6'	97° 03.1'	375	82	June	8	NS	5	Bottom	

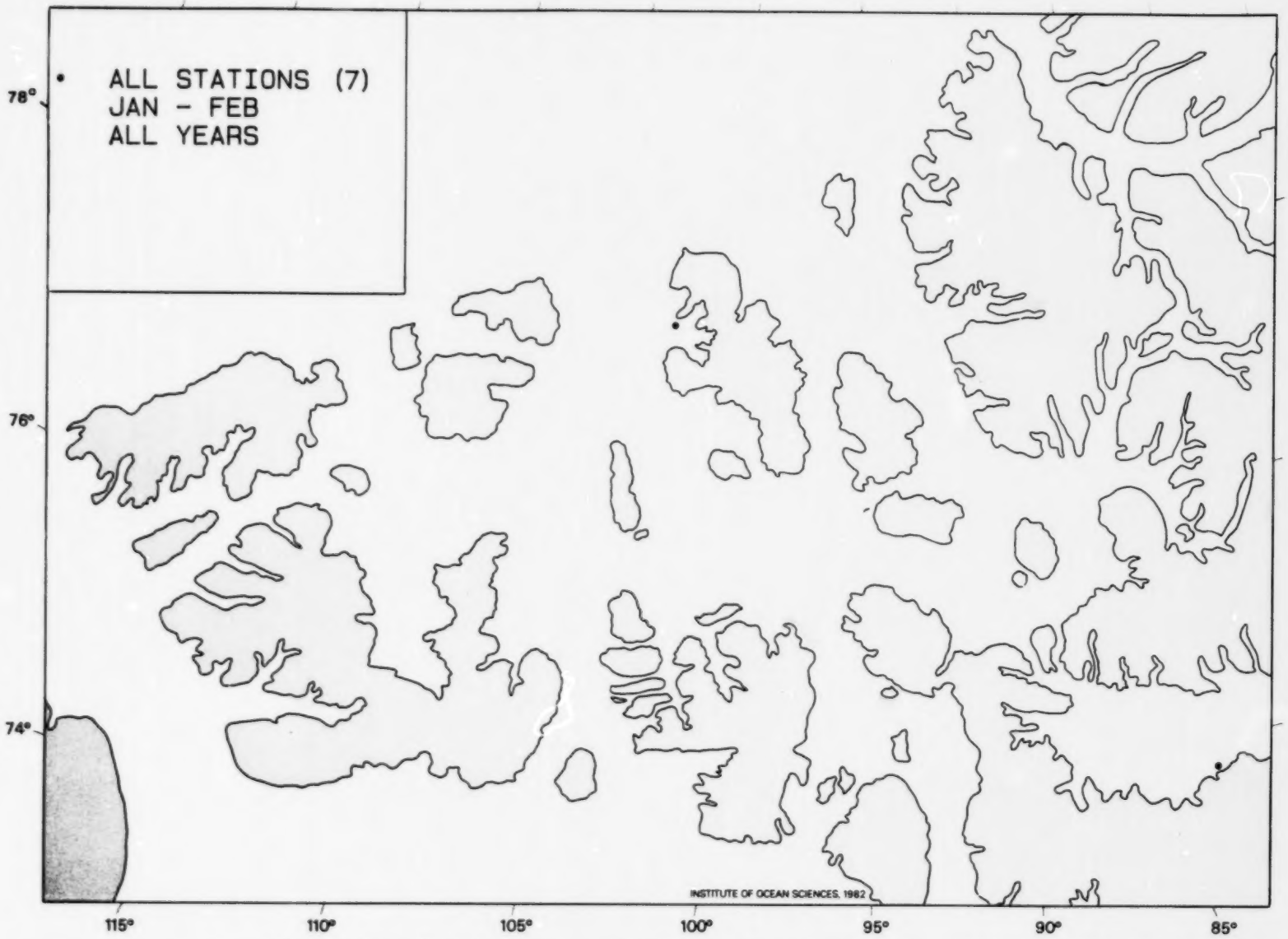
DATA SET NUMBER	STATION NUMBER	LATITUDE o N	LONGITUDE o W	STATION DEPTH (m)	TIME SAMPLED				NUMBER POINTS	MAXIMUM DEPTH SAMPLED (m)	REMARKS
					YEAR	MONTH	DAY	HOUR GMT			
83-0056	4835-A2	76o 39.3'	97o 00.3'	252	83	March	29	22.3	4	240	
	4844-A2	76o 40.4'	97o 09.1'	373	83	April	1	19.8	3	344	
	4845-A2	76o 40.4'	97o 09.1'	373	83	April	1	20.4	2	214	
	4846-A2	76o 40.4'	97o 09.1'	375	83	April	1	21.0	3	102	
	4832-A4	76o 35.5'	97o 43.1'	166	83	March	29	19.6	4	124	
	4808-B2	77o 37.0'	102o 18.3'	299	83	March	24	17.2	4	299	
	4809-B4	77o 30.0'	104o 28.7'	314	83	March	24	19.3	4	301	
	4824-P1	78o 28.8'	105o 33.2'	493	83	March	27	23.1	4	398	
	4842-V1	77o 23.2'	92o 09.2'	445	83	April	1	17.0	4	381	
83-0057	NS	76o 06.2'	82o 25.0'	NS	83	August	15	NS	2	18	
	NS	76o 25.0'	83o 05.0'	NS	83	August	17	NS	2	22	
	NS	76o 00.0'	82o 02.5'	NS	83	August	19	NS	1	5	
	NS	76o 05.9'	82o 26.0'	NS	83	August	21	NS	2	50	
	NS	76o 04.8'	82o 09.4'	NS	83	August	22	NS	2	12.5	
	NS	76o 12.5'	82o 34.0'	NS	83	August	27	NS	2	9	
	NS	75o 45.0'	80o 29.0'	NS	83	August	16	NS	13	100	
	NS	76o 03.5'	82o 20.0'	NS	83	August	18	NS	13	100	
	NS	76o 06.5'	82o 20.0'	NS	83	August	20	NS	13	100	
	NS	76o 14.0'	82o 45.0'	NS	83	August	28	NS	13	100	
	NS	76o 15.8'	82o 36.5'	NS	83	August	29	NS	13	100	
	NS	76o 04.5'	82o 12.0'	NS	83	August	13	NS	13	100	
	NS	76o 04.5'	82o 12.0'	NS	83	August	14	NS	13	100	
85-0015	15	77o 43.2'	116o 00.1'	NS	85	April	24	NS	12	90	

11. MAPS

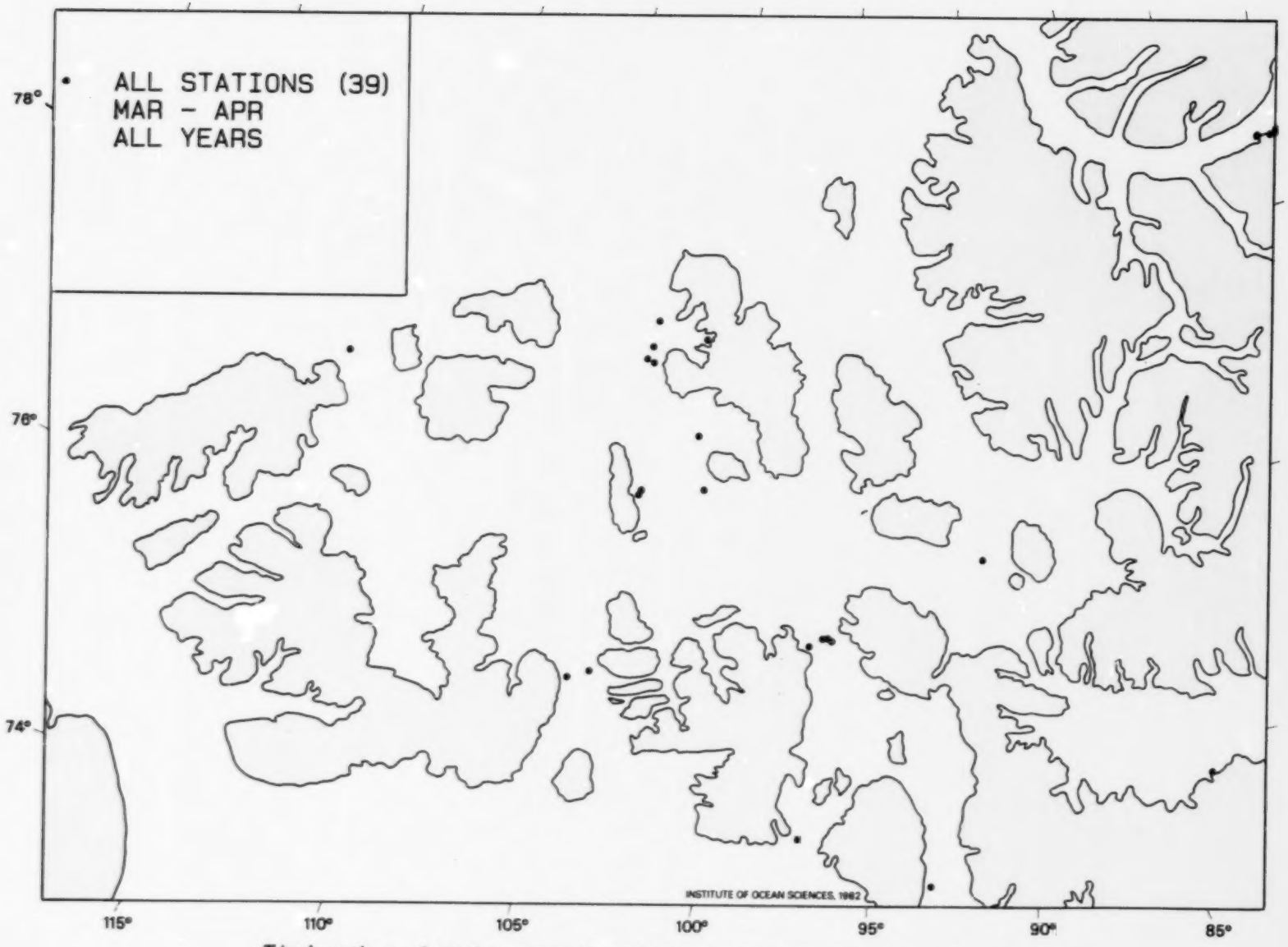
11.1 Geographical Occurrence of Chemical Oceanographic Data on a Cumulative Bi-monthly Basis.



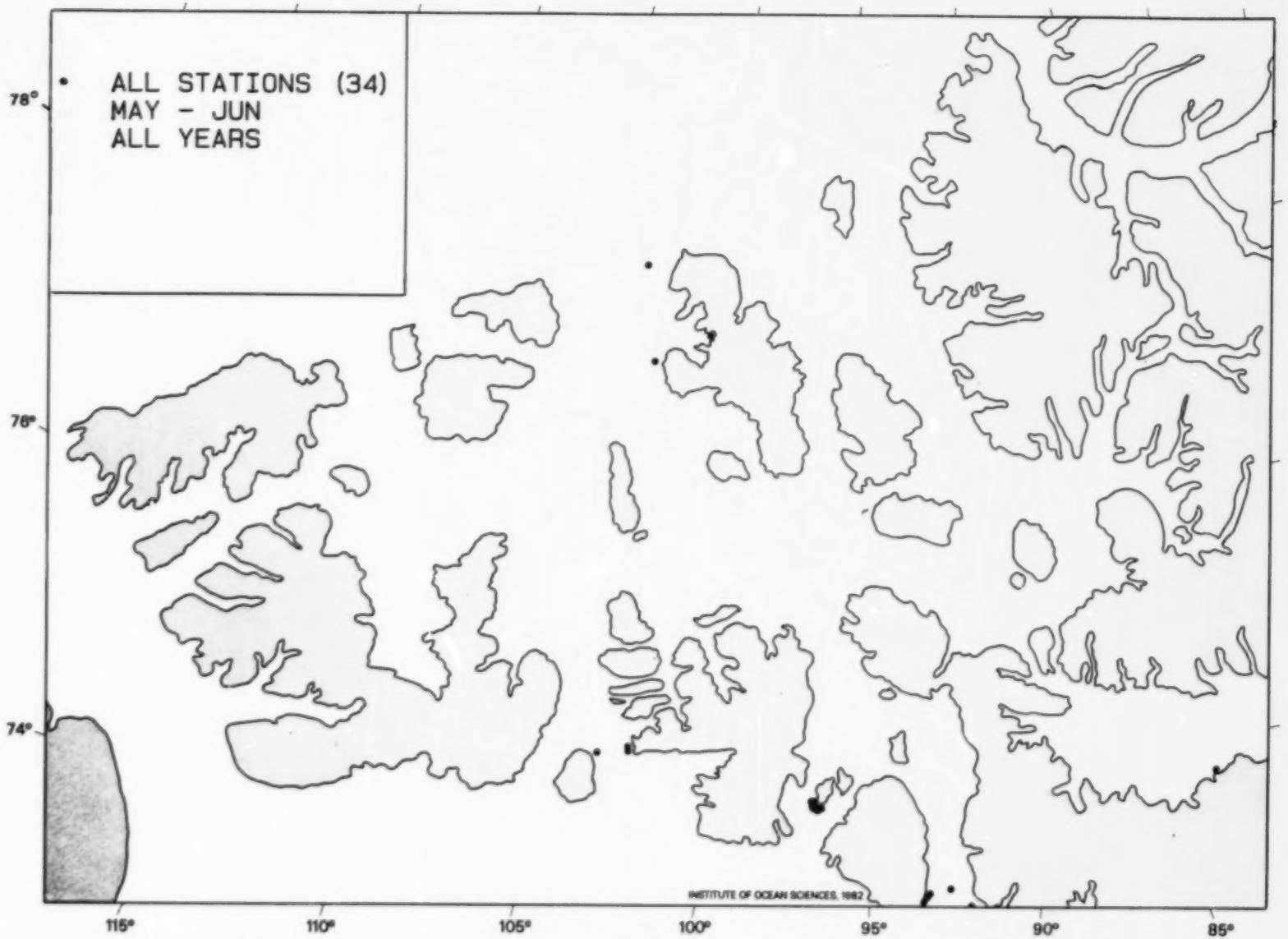
The locations of stations reporting chemical oceanographic data, all years (1952 - 1985).



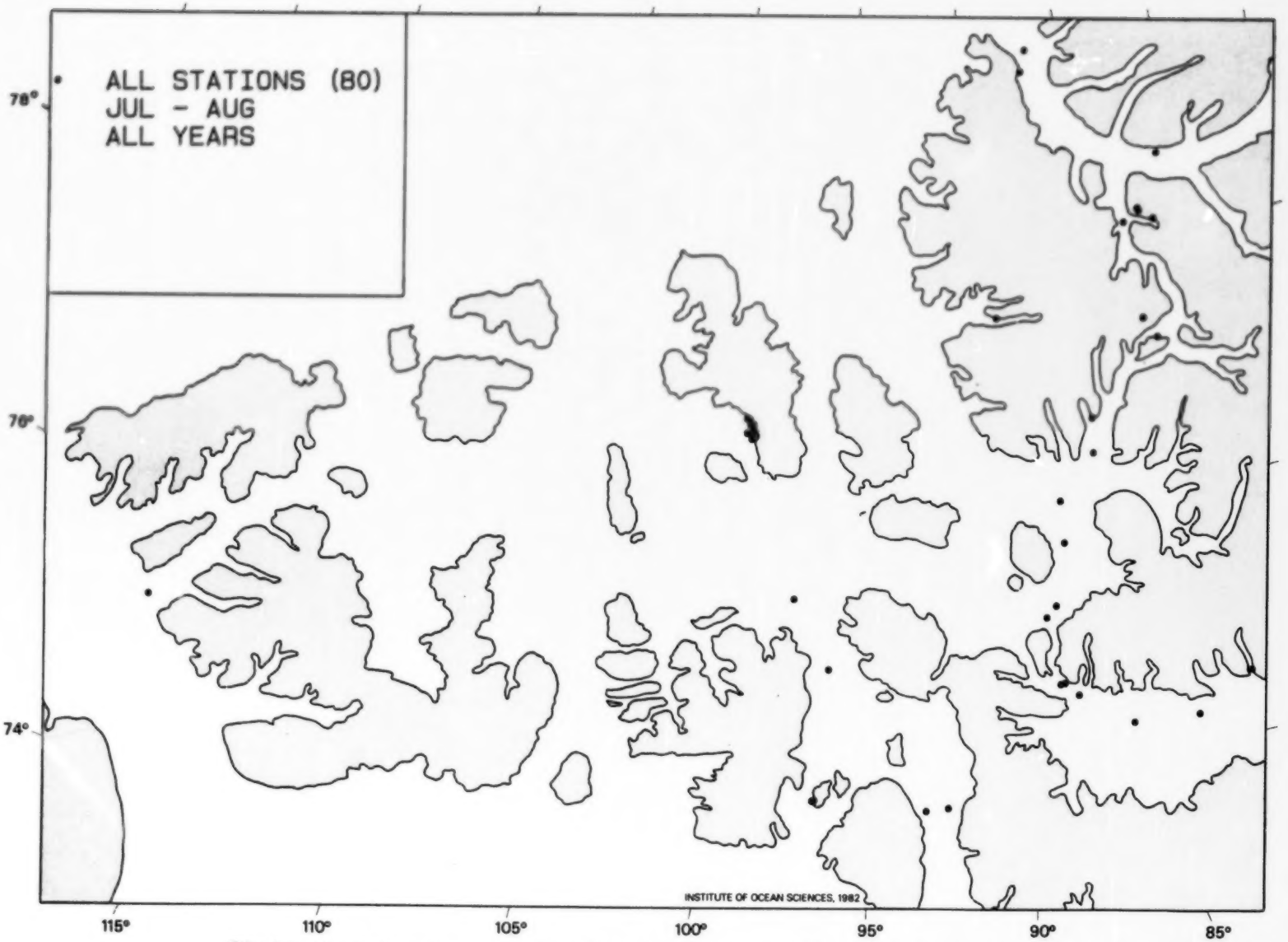
The locations of stations reporting chemical oceanographic data collected during January - February, all years.



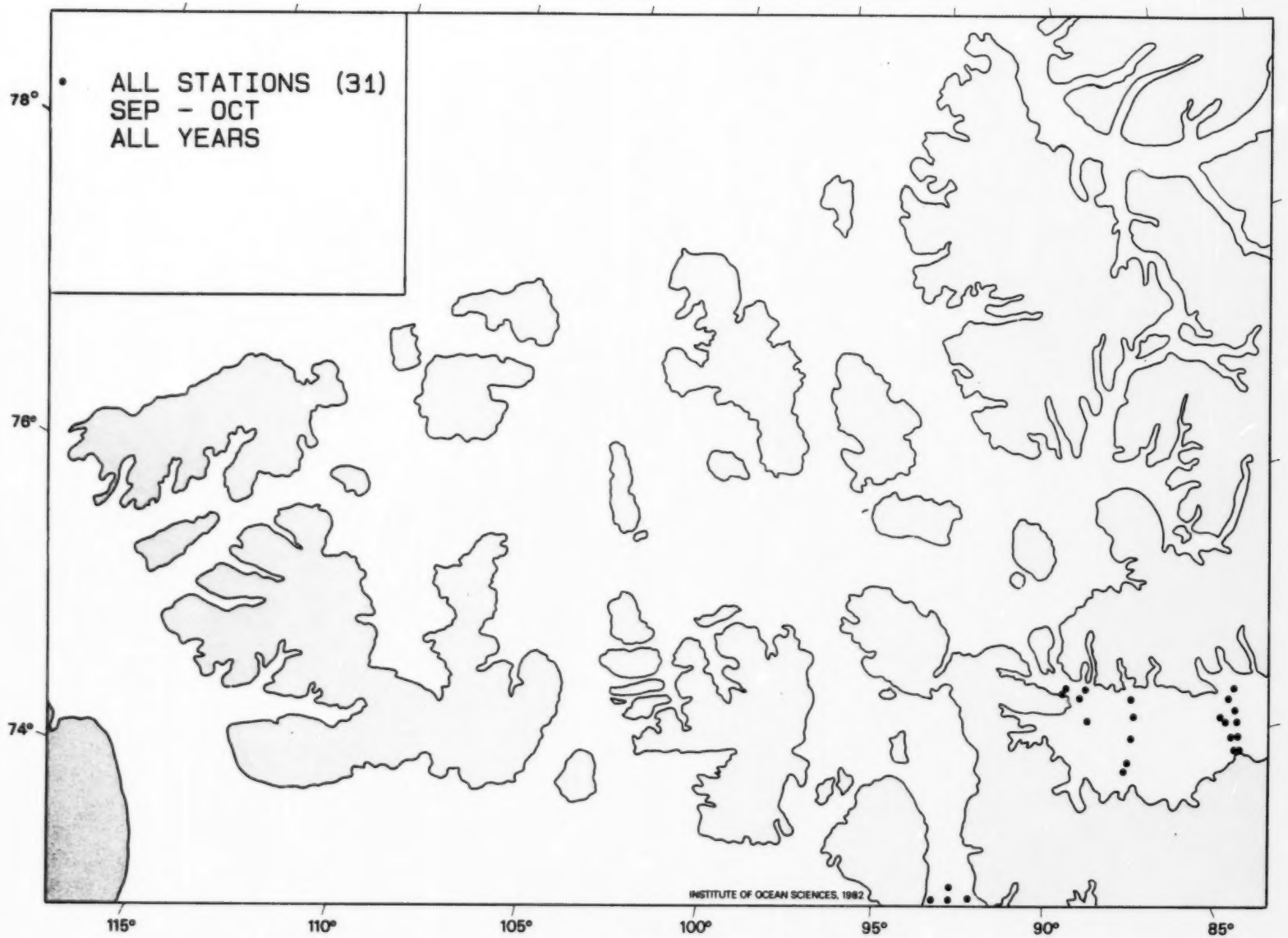
The locations of stations reporting chemical oceanographic data collected during March - April, all years.



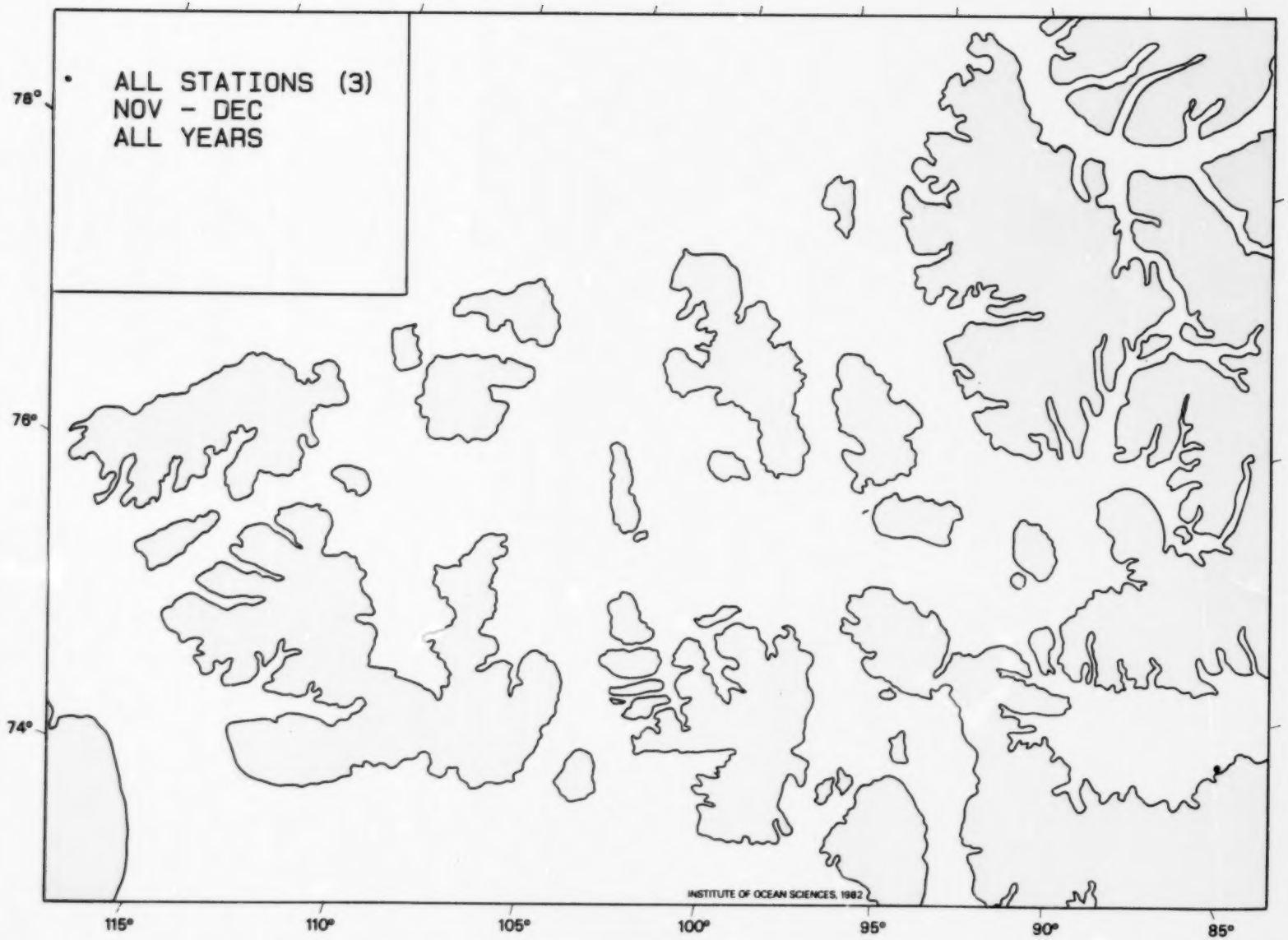
The locations of stations reporting chemical oceanographic data collected during May - June, all years.



The locations of stations reporting chemical oceanographic data collected during July - August, all years.

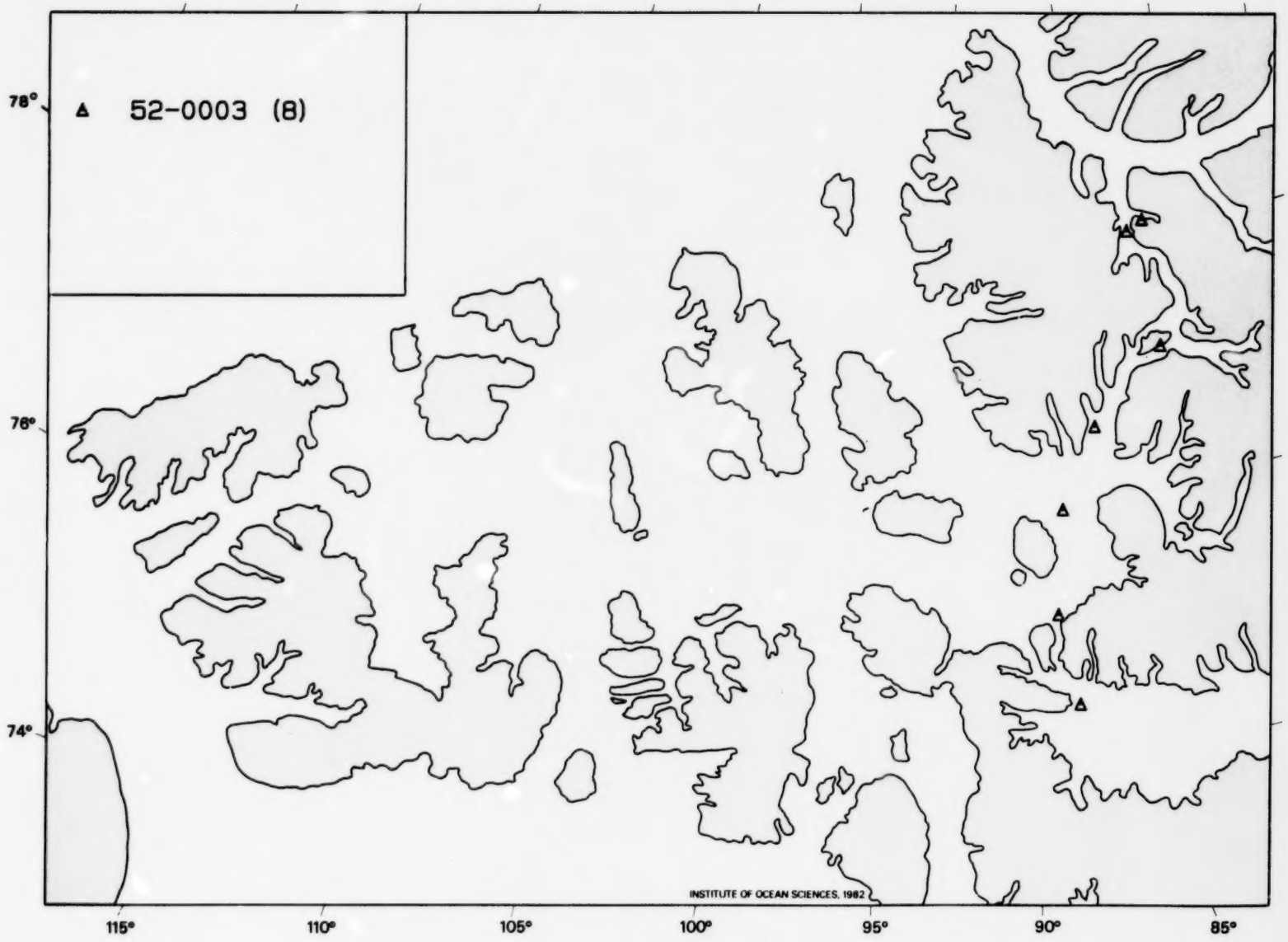


The locations of stations reporting chemical oceanographic data collected during September - October, all years.



The locations of stations reporting chemical oceanographic data collected during November - December, all years.

11.2 Geographical Occurrences of Chemical Oceanographic Data on a Yearly Basis.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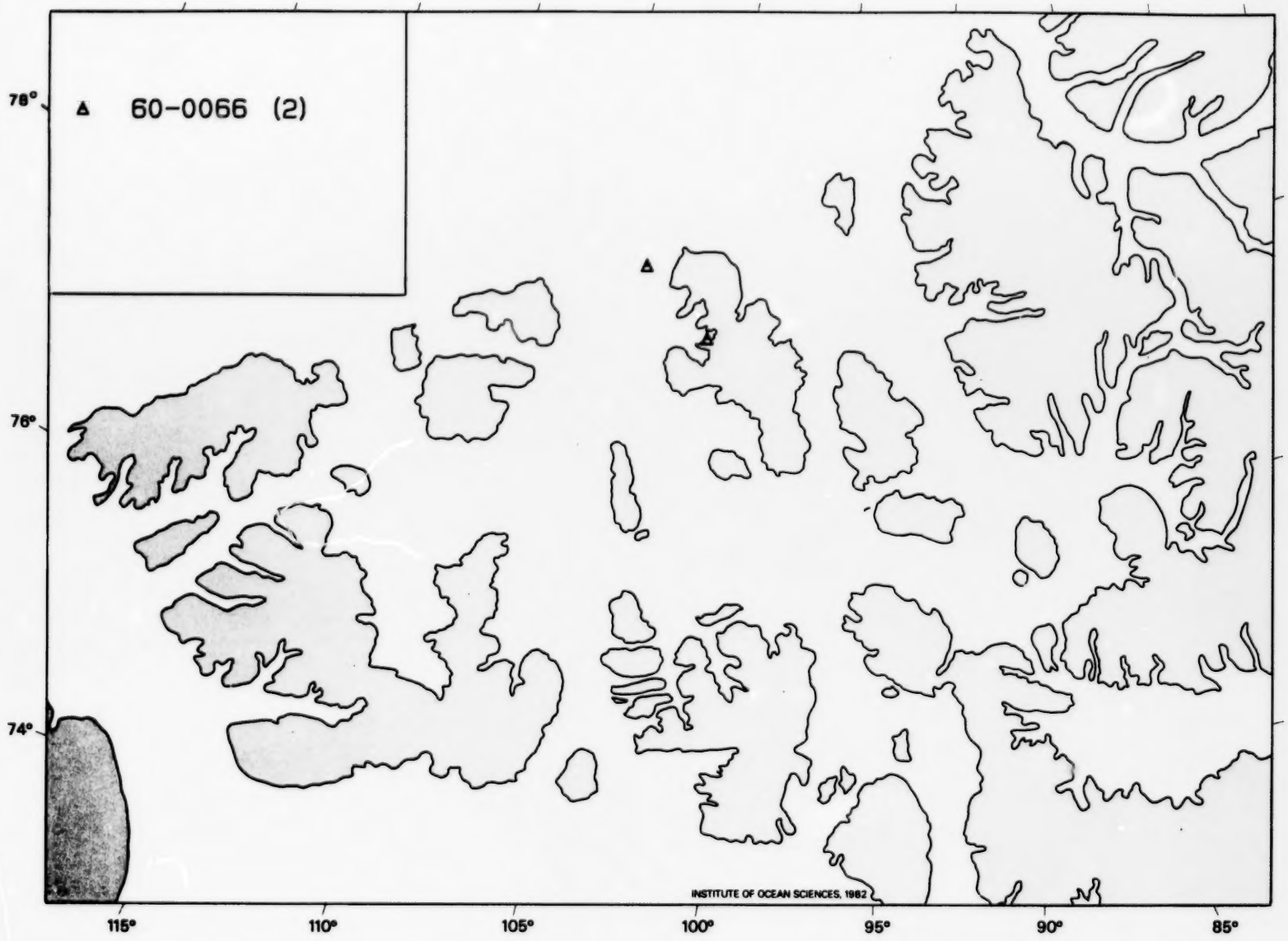
INSTITUTE OF OCEAN SCIENCES, 1982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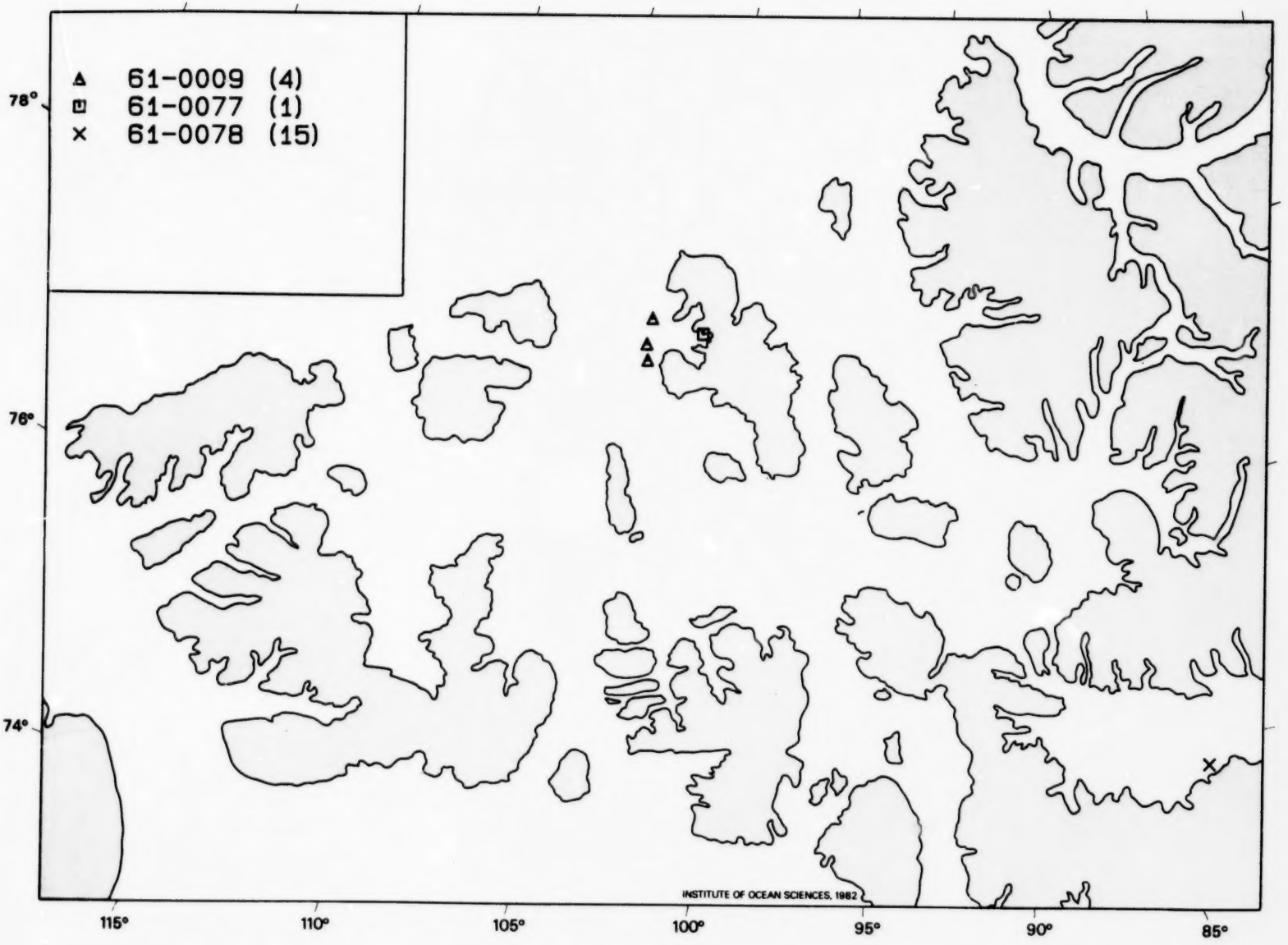
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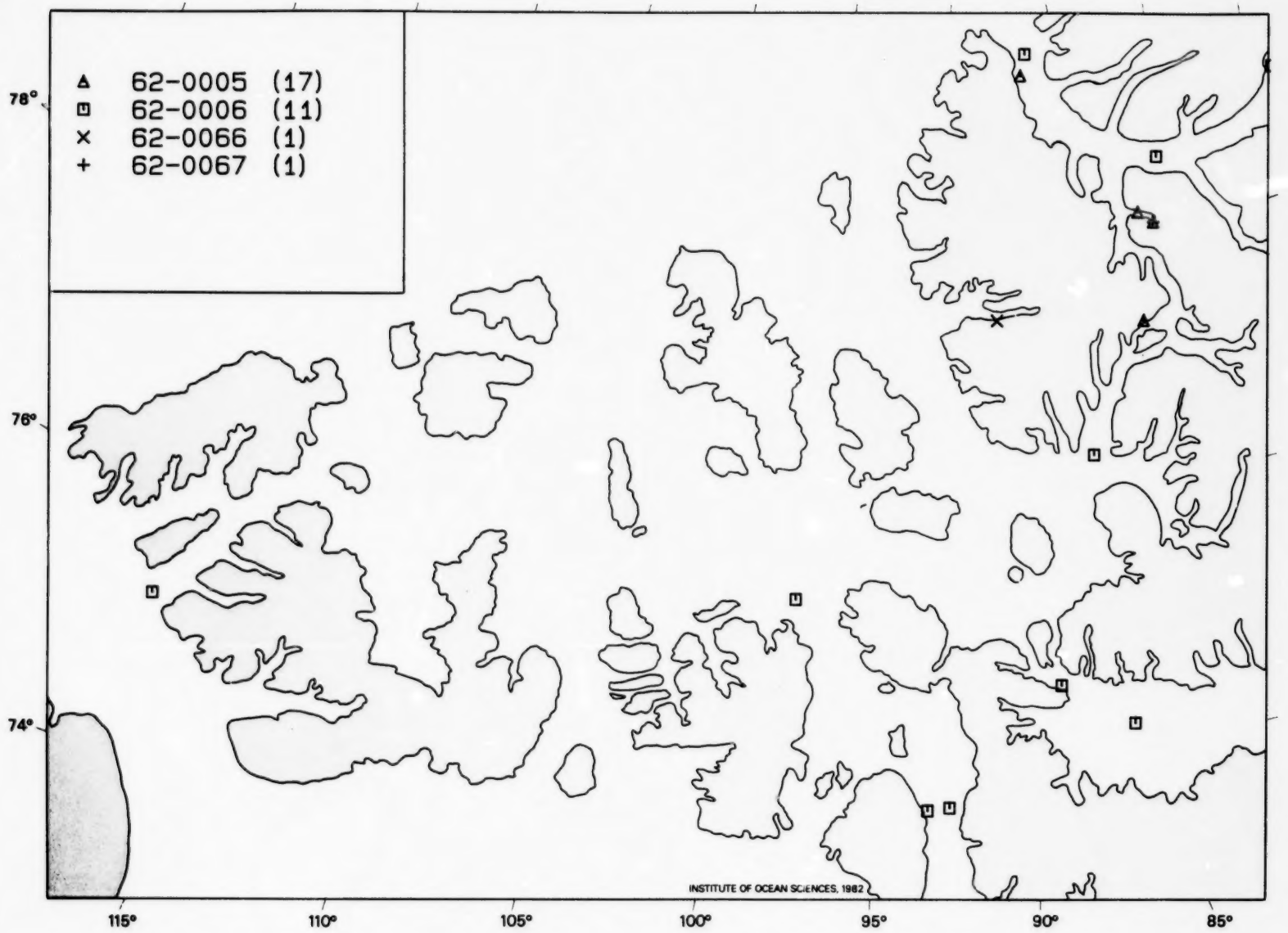
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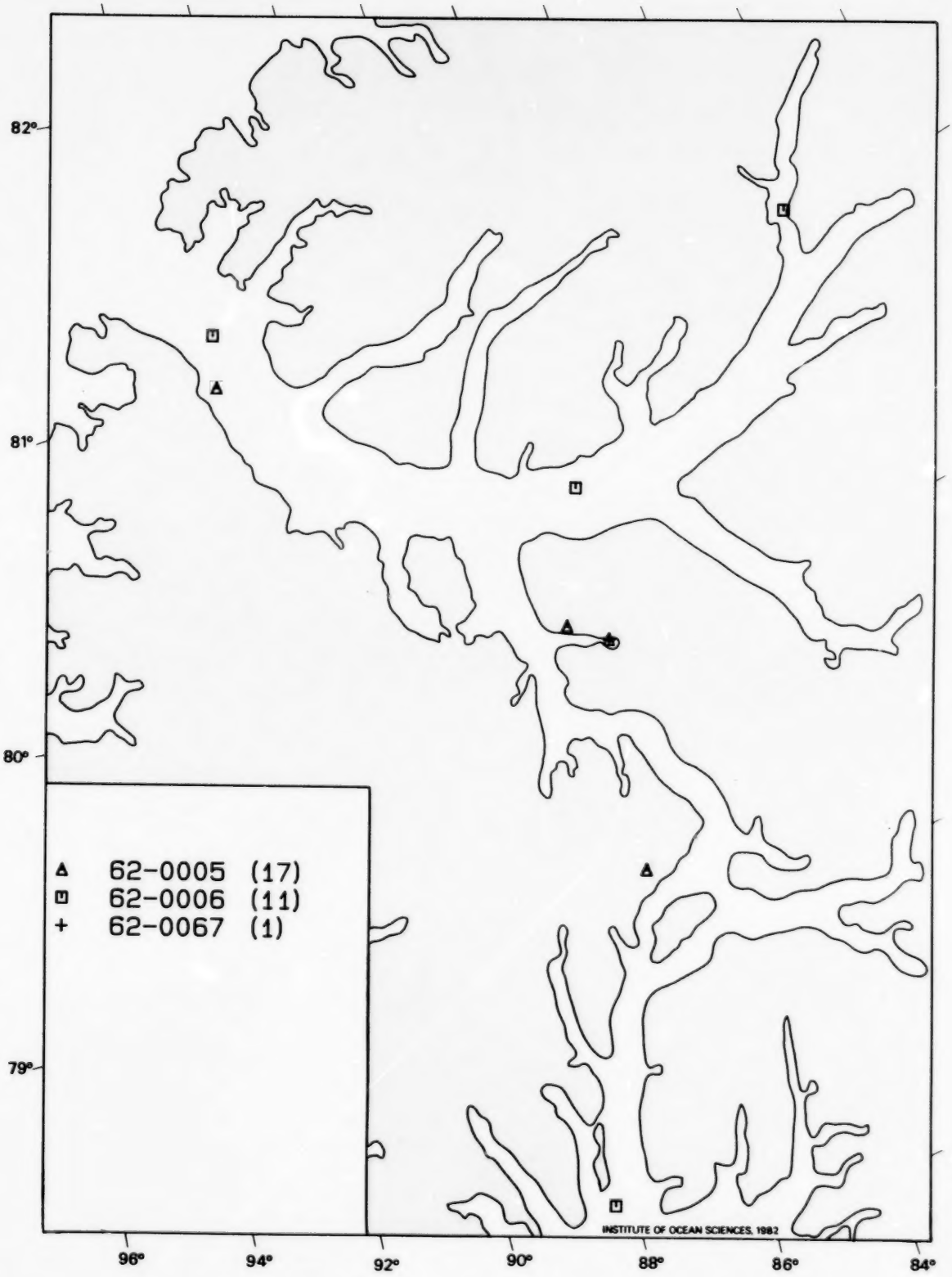
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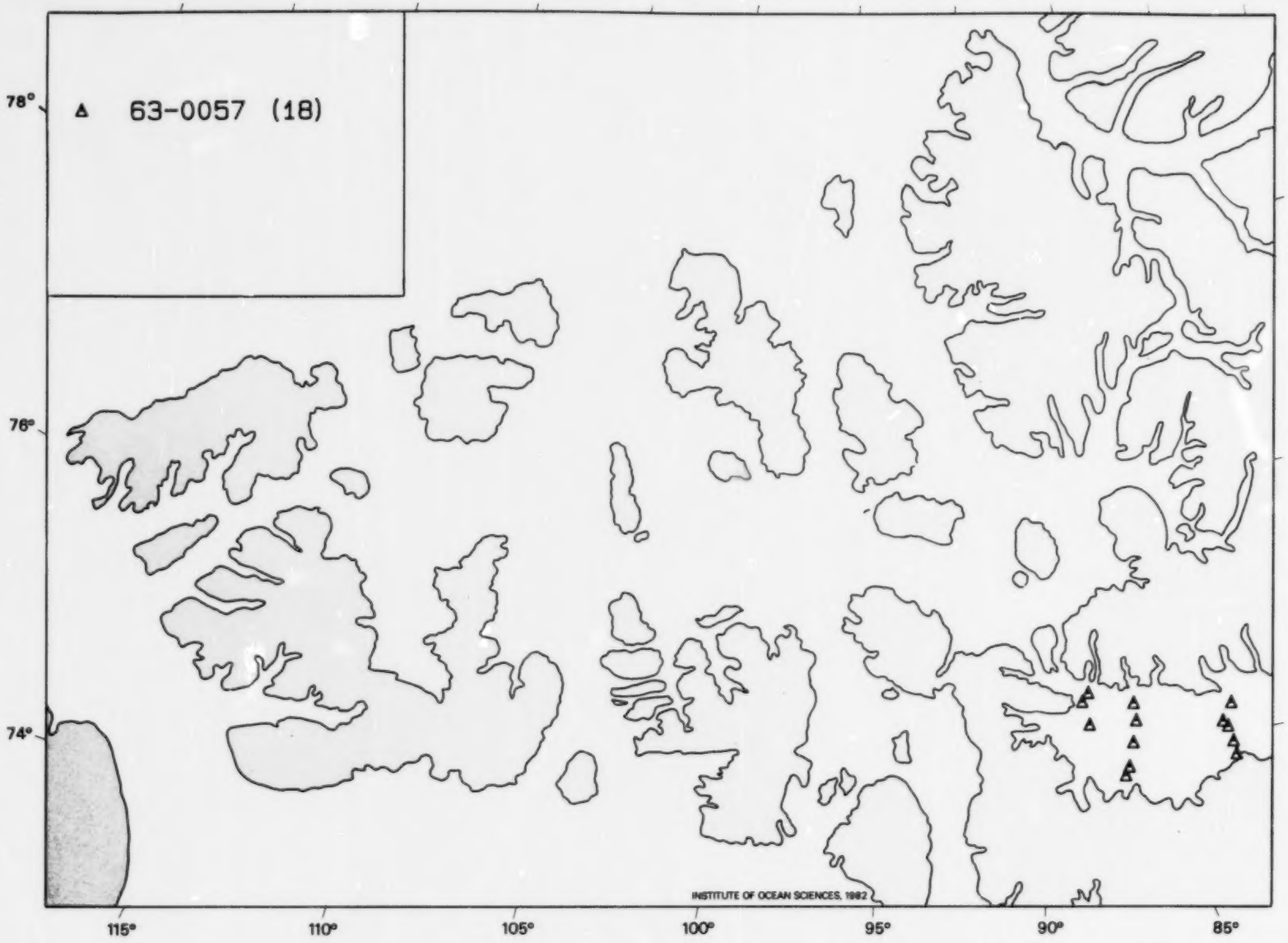
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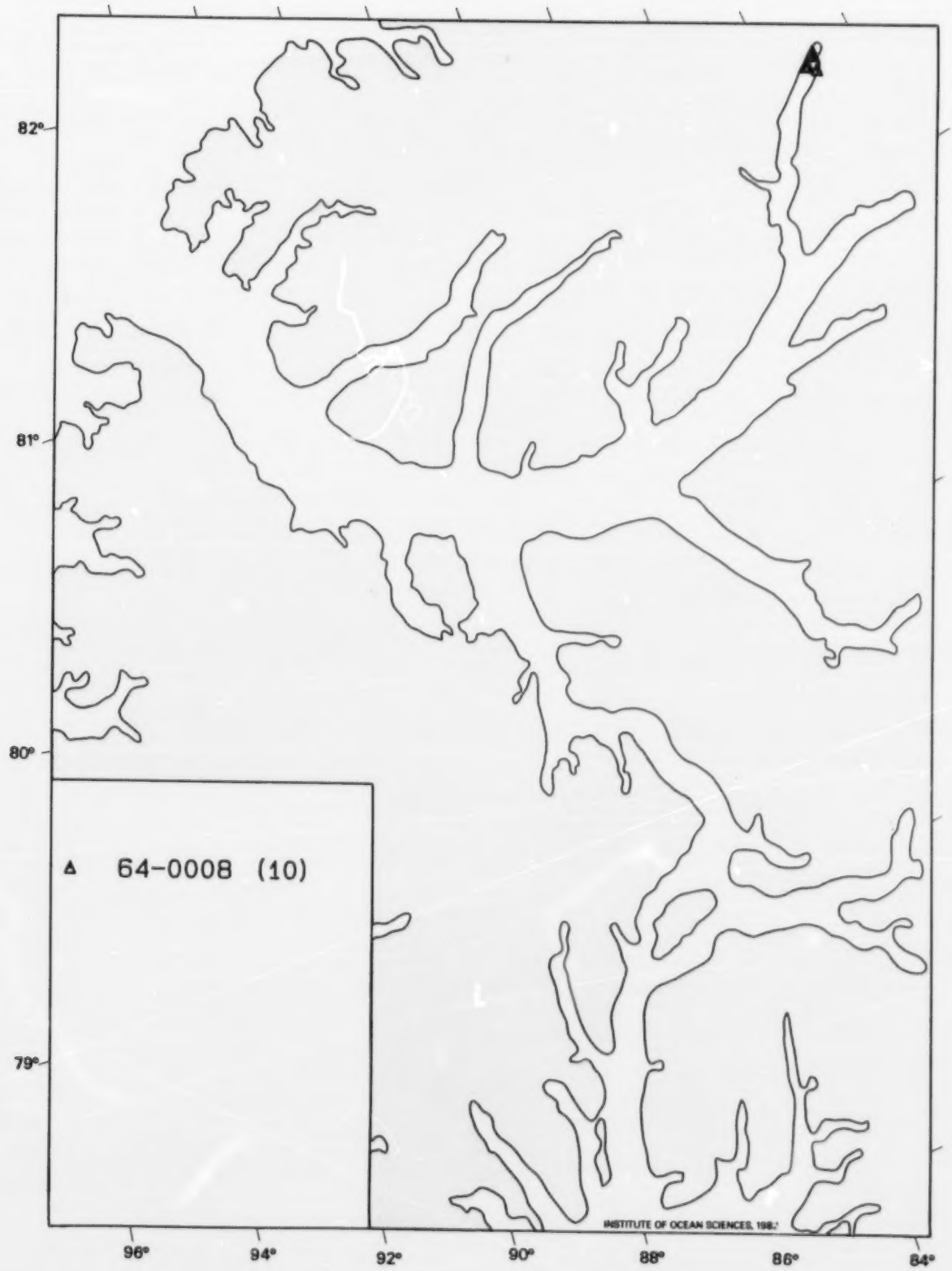
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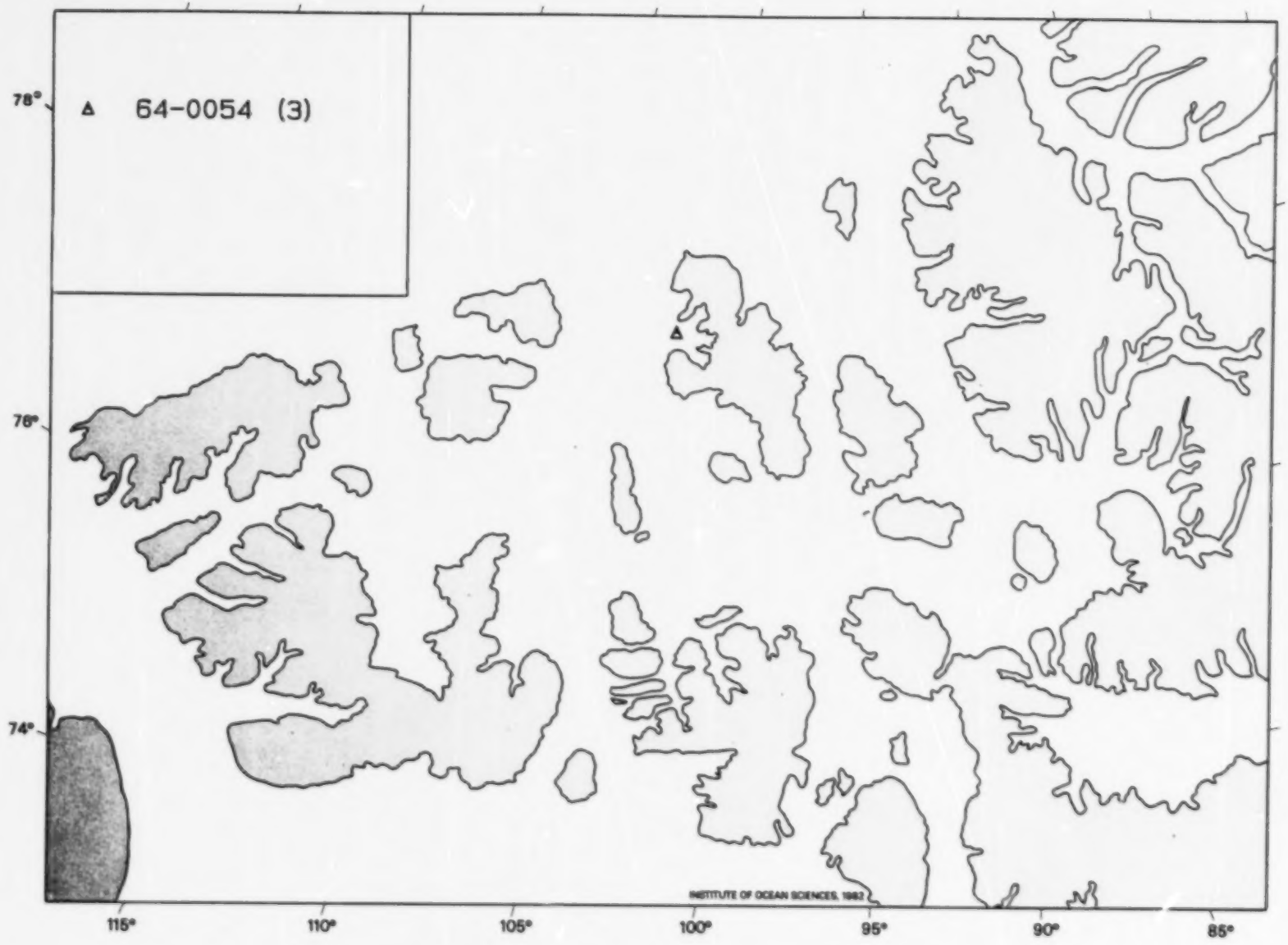
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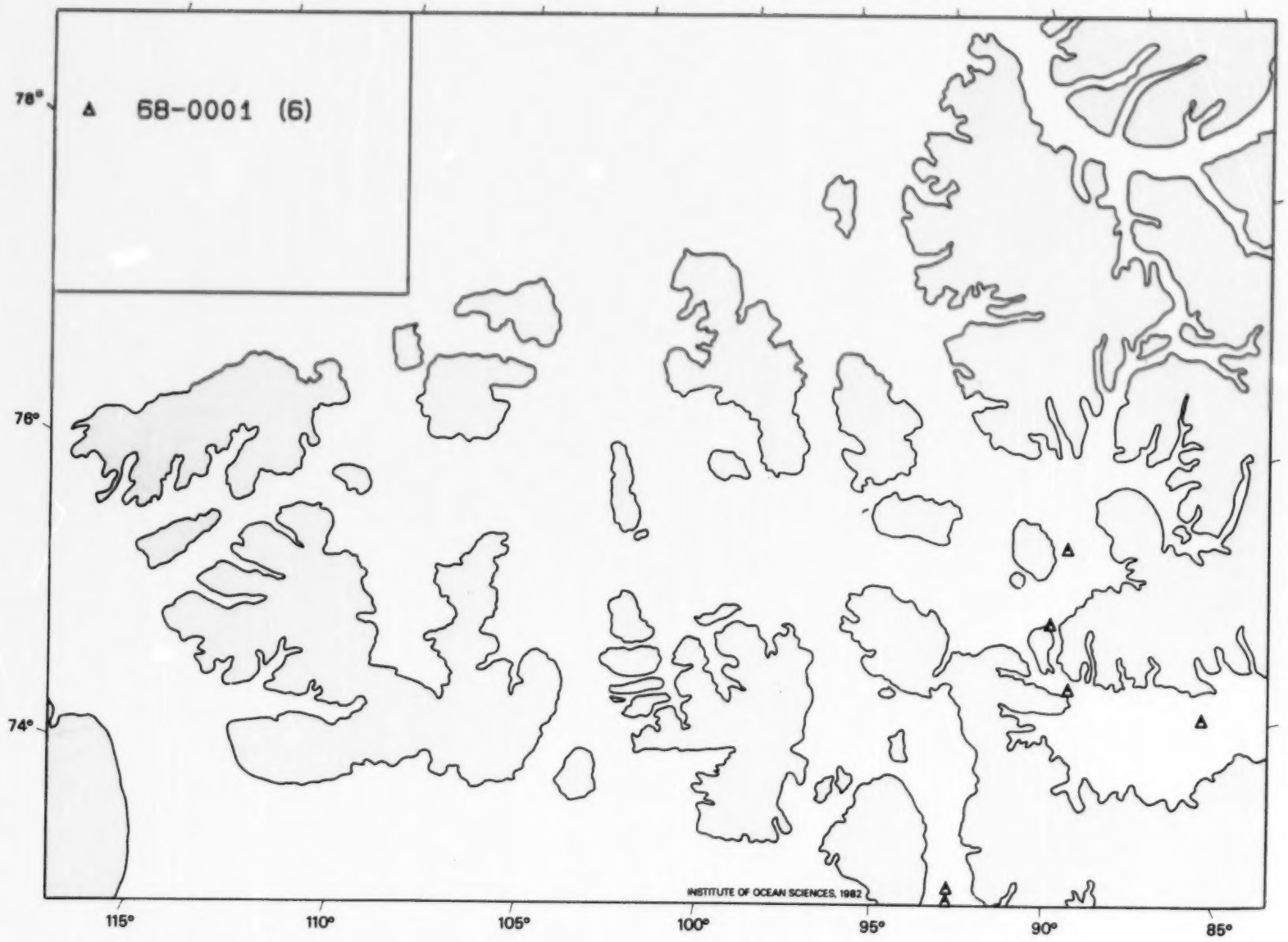
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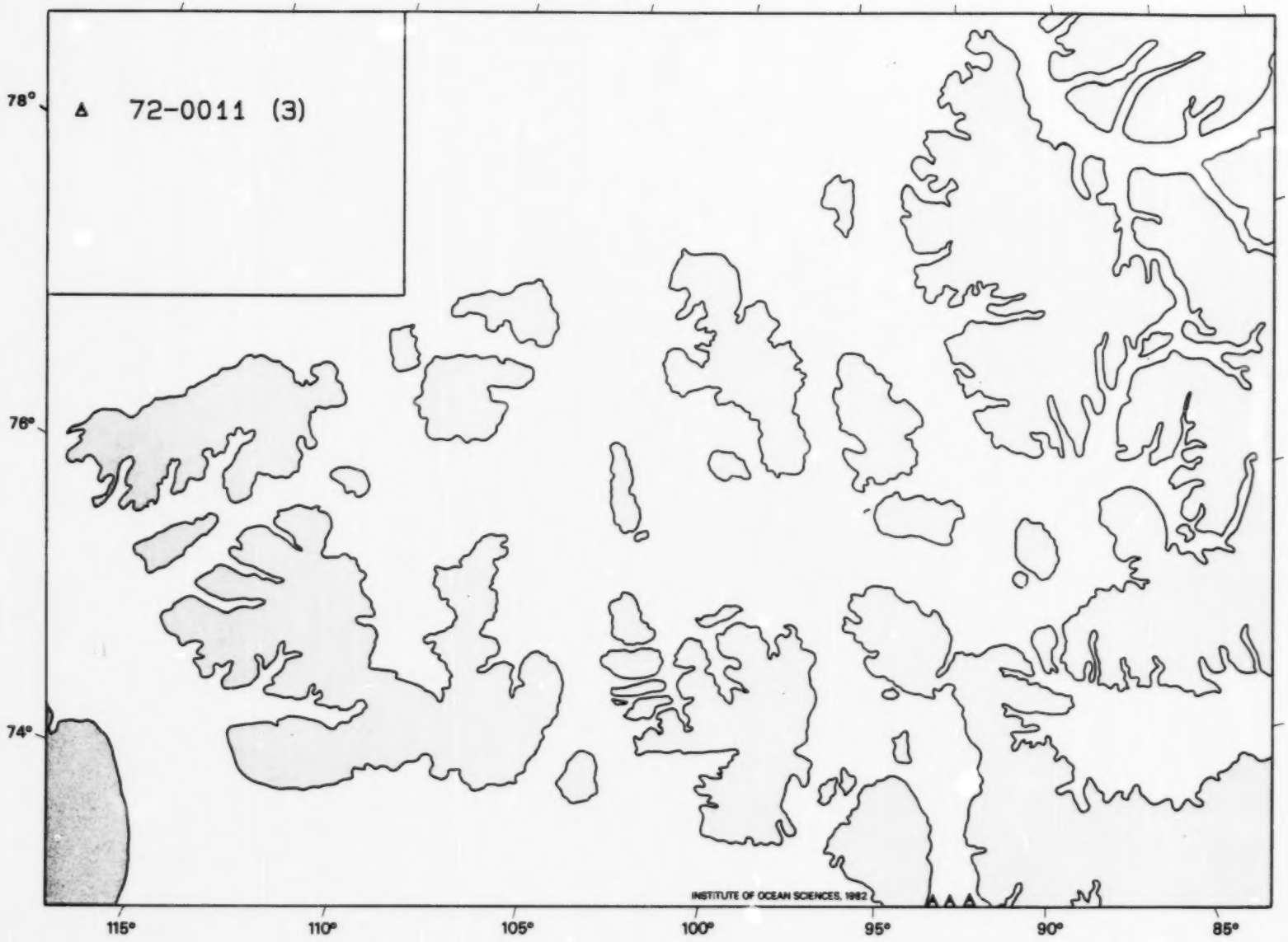
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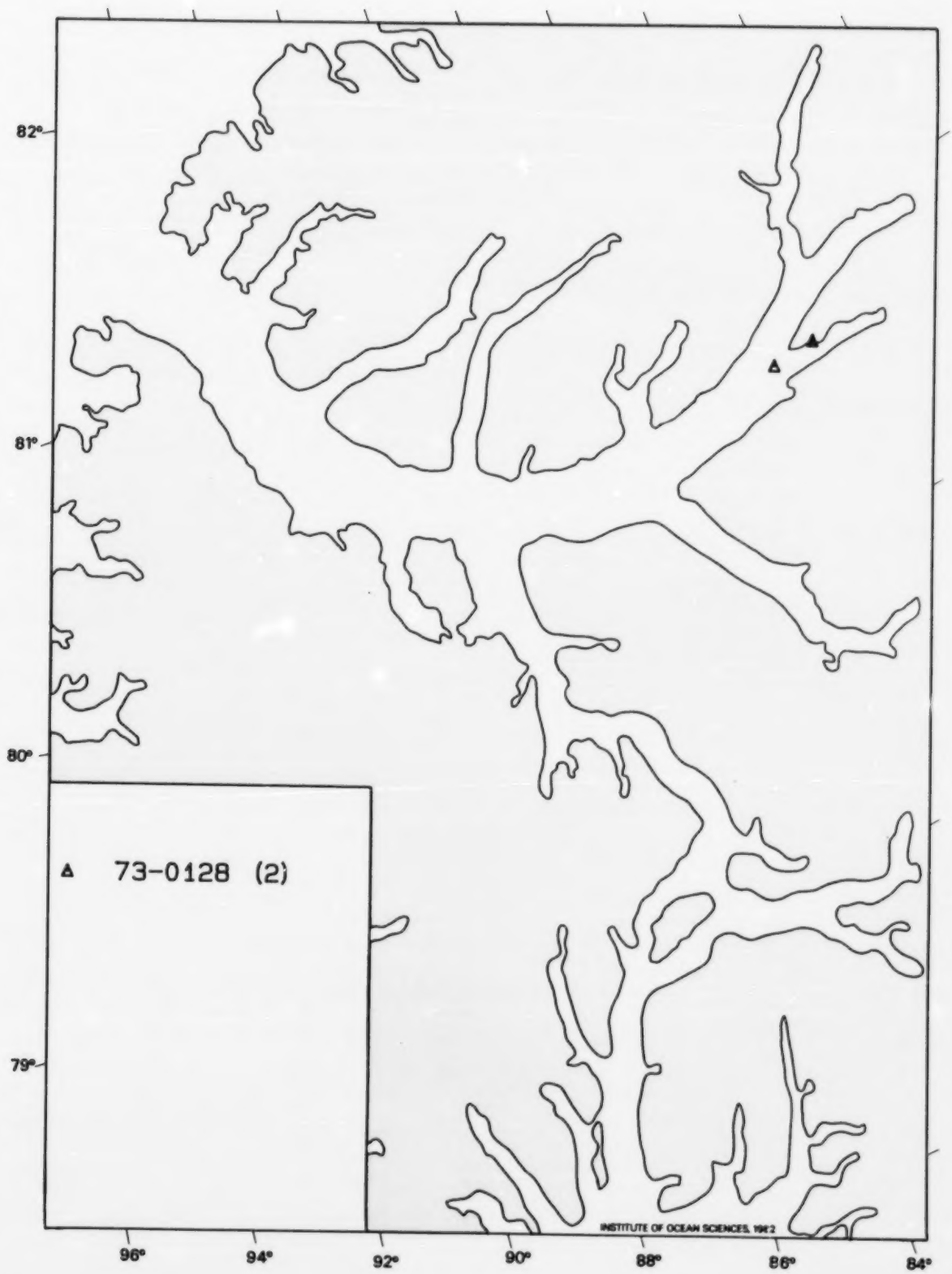
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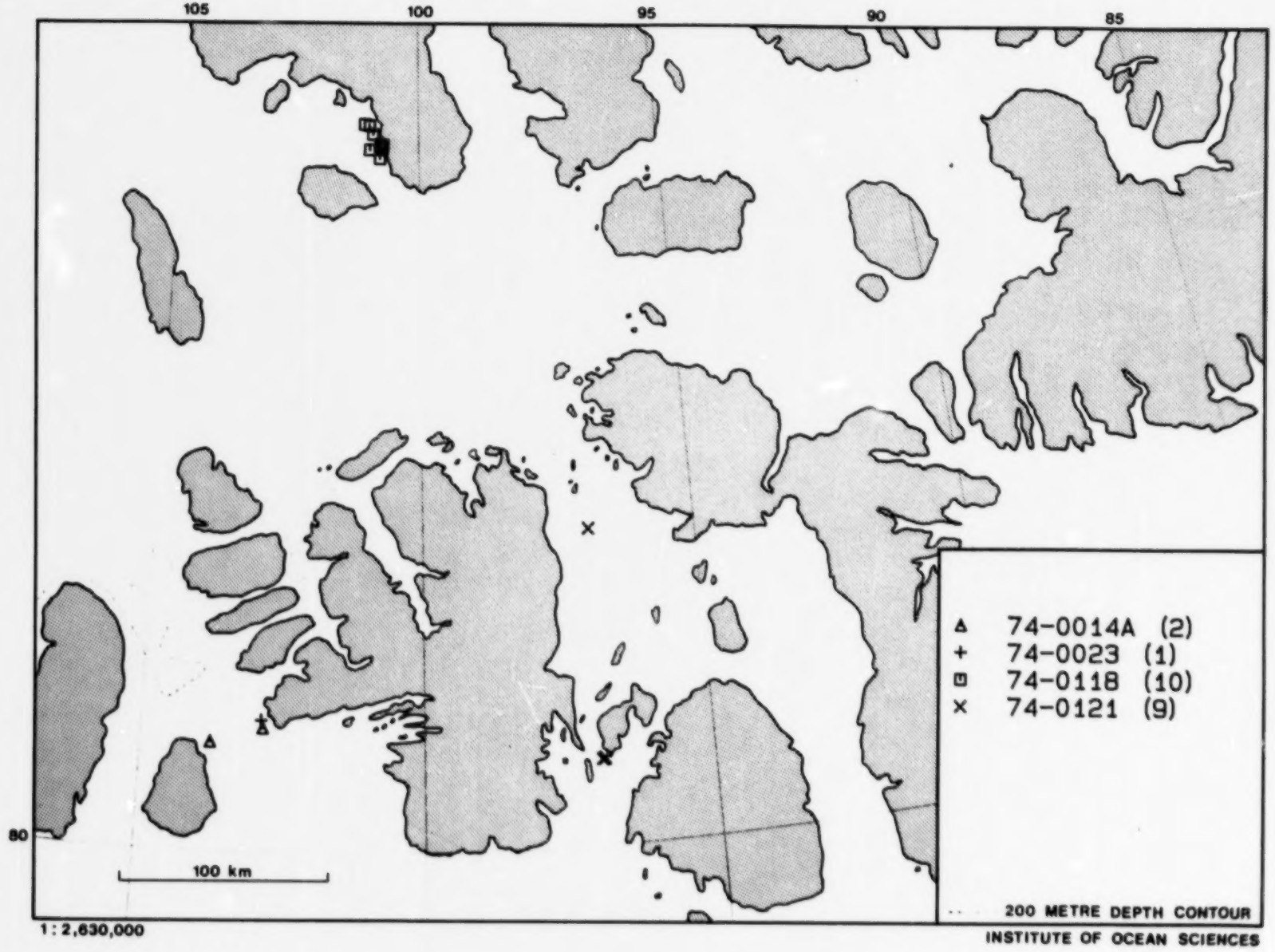
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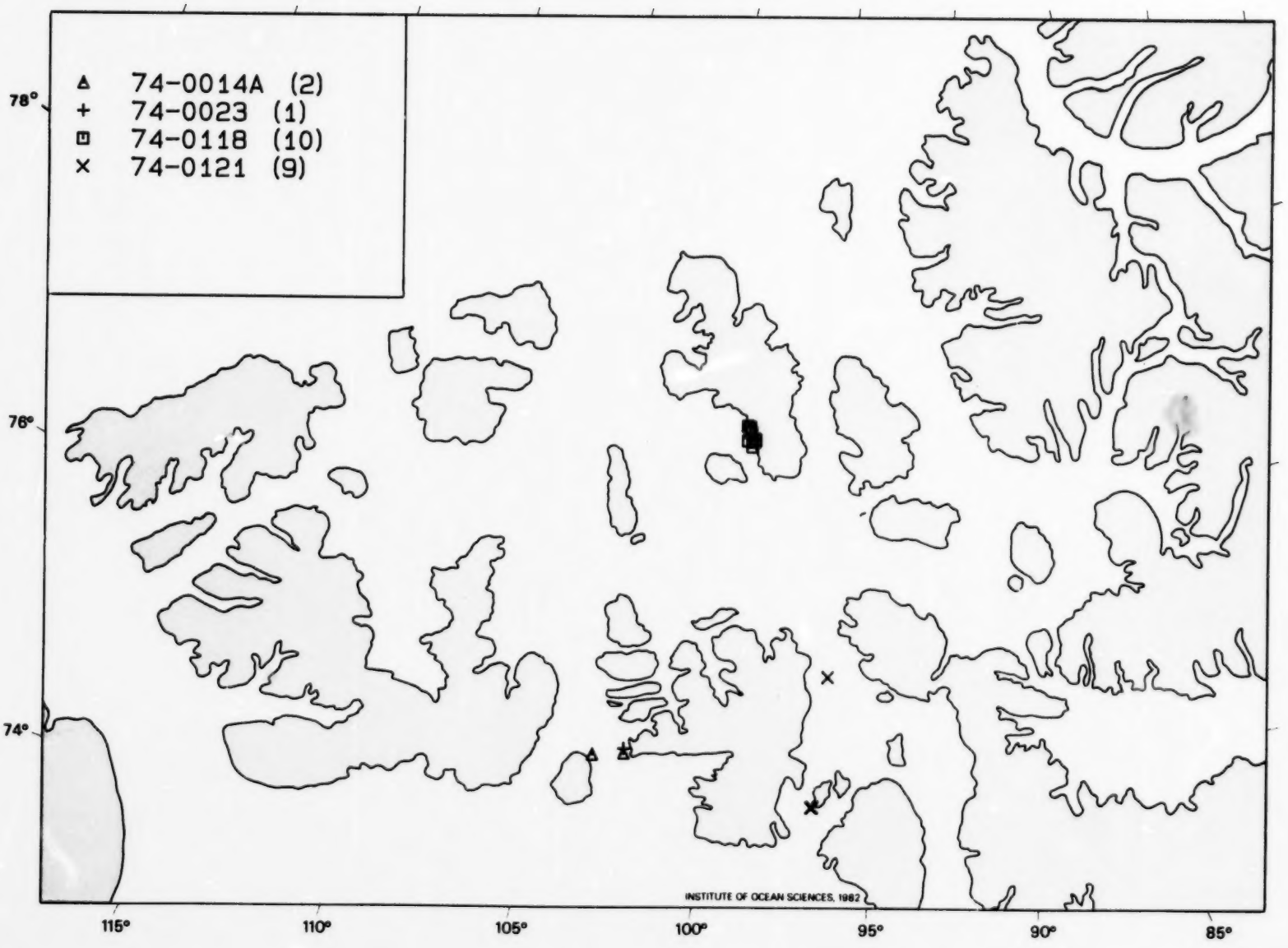
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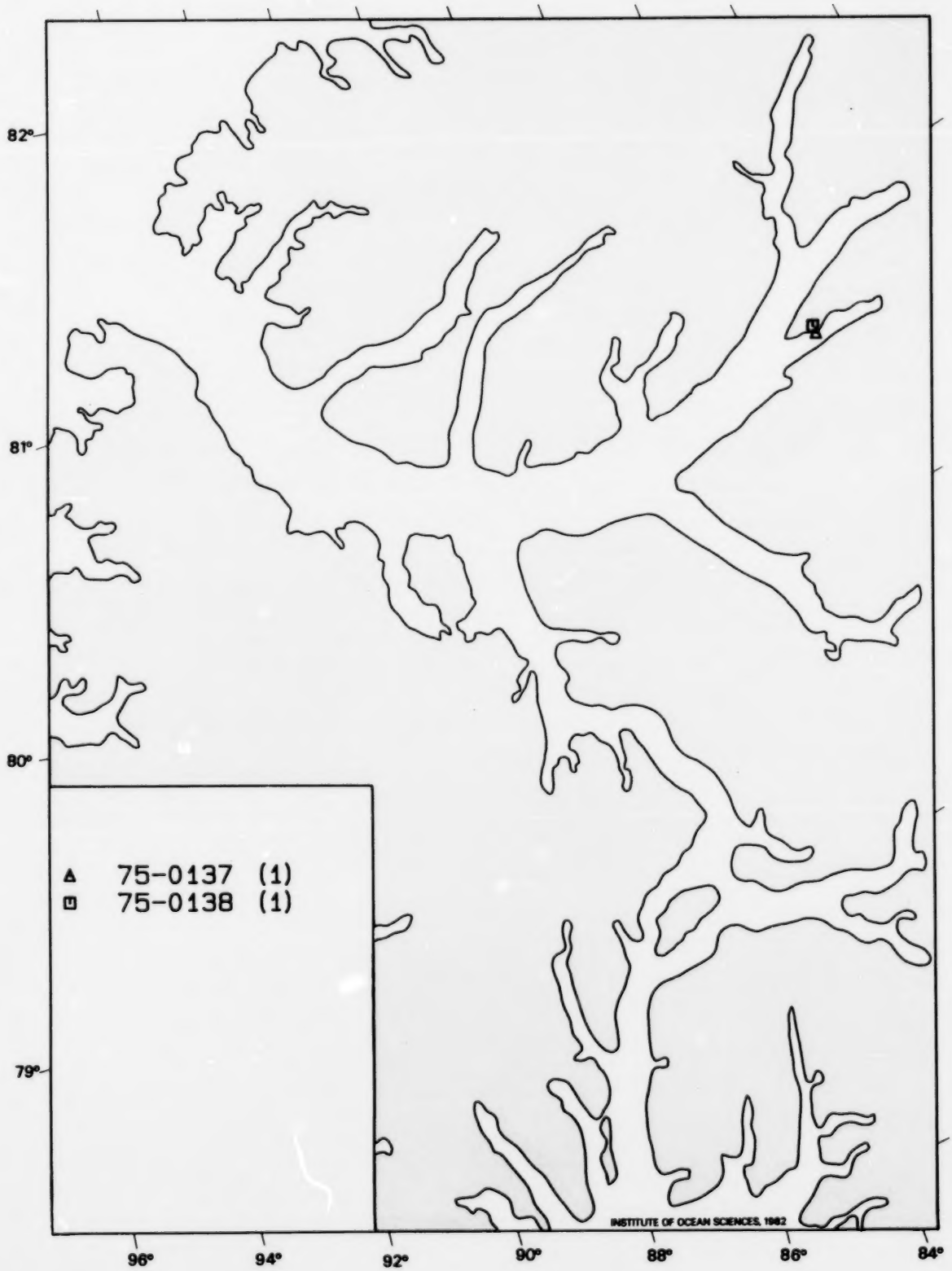
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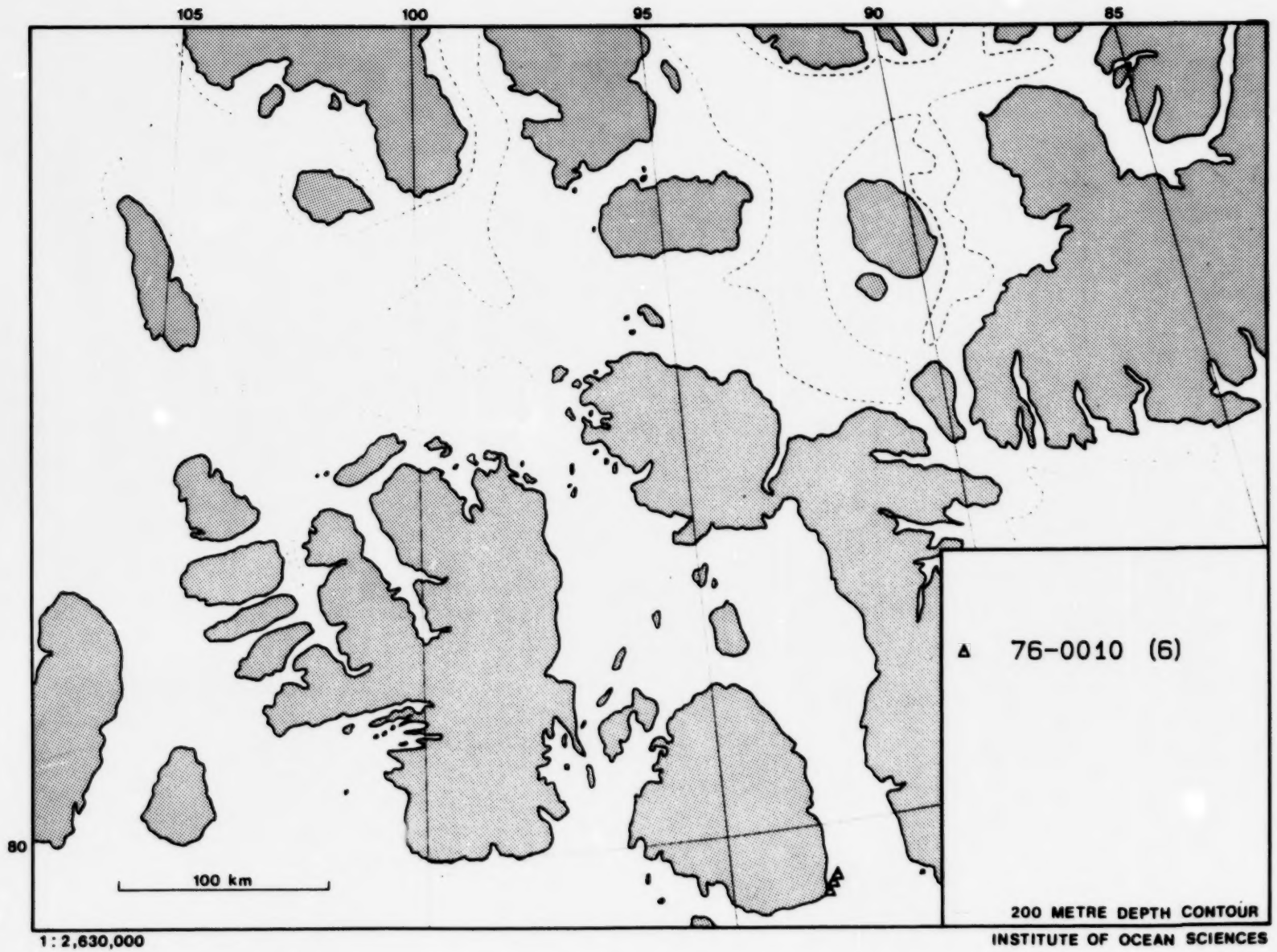
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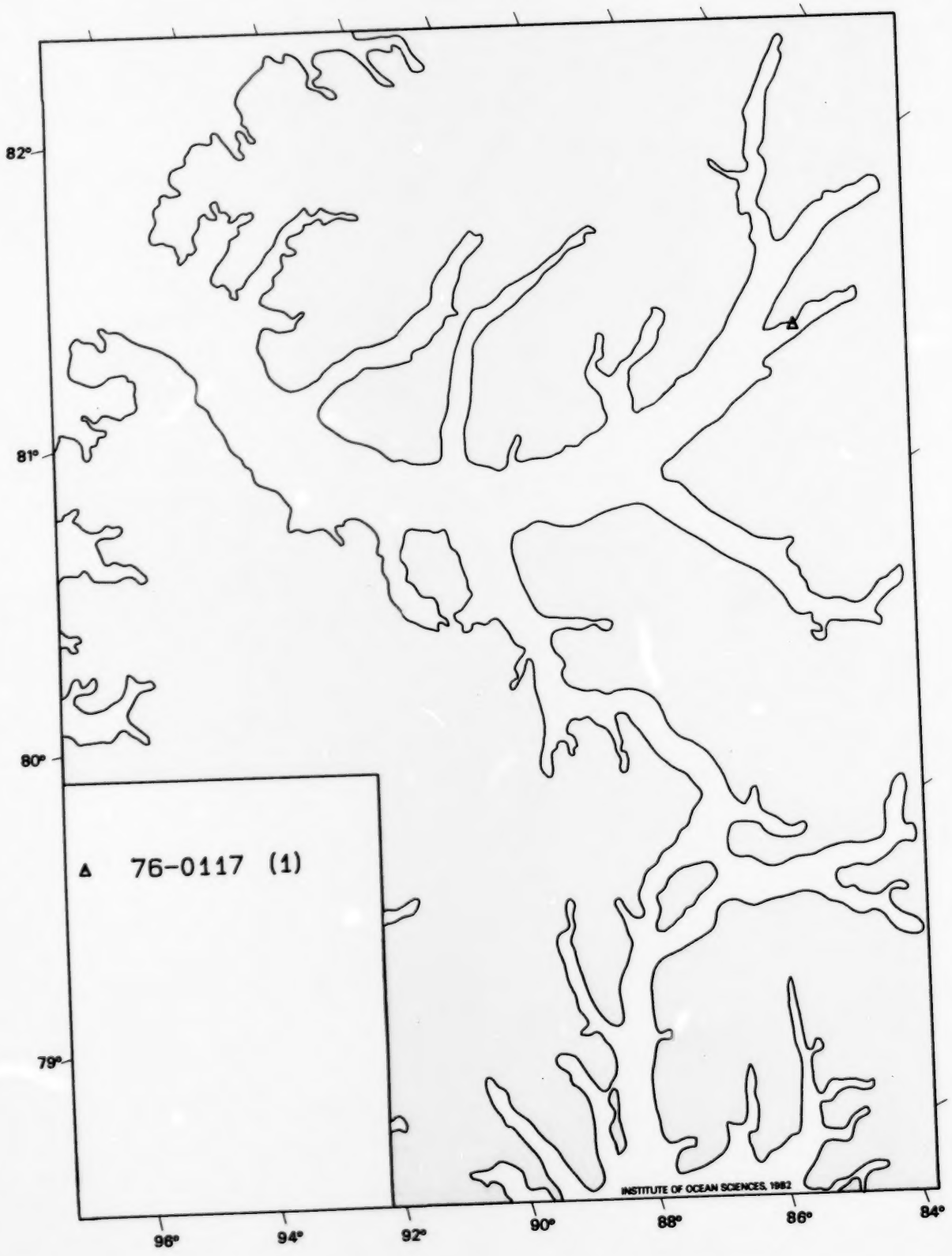
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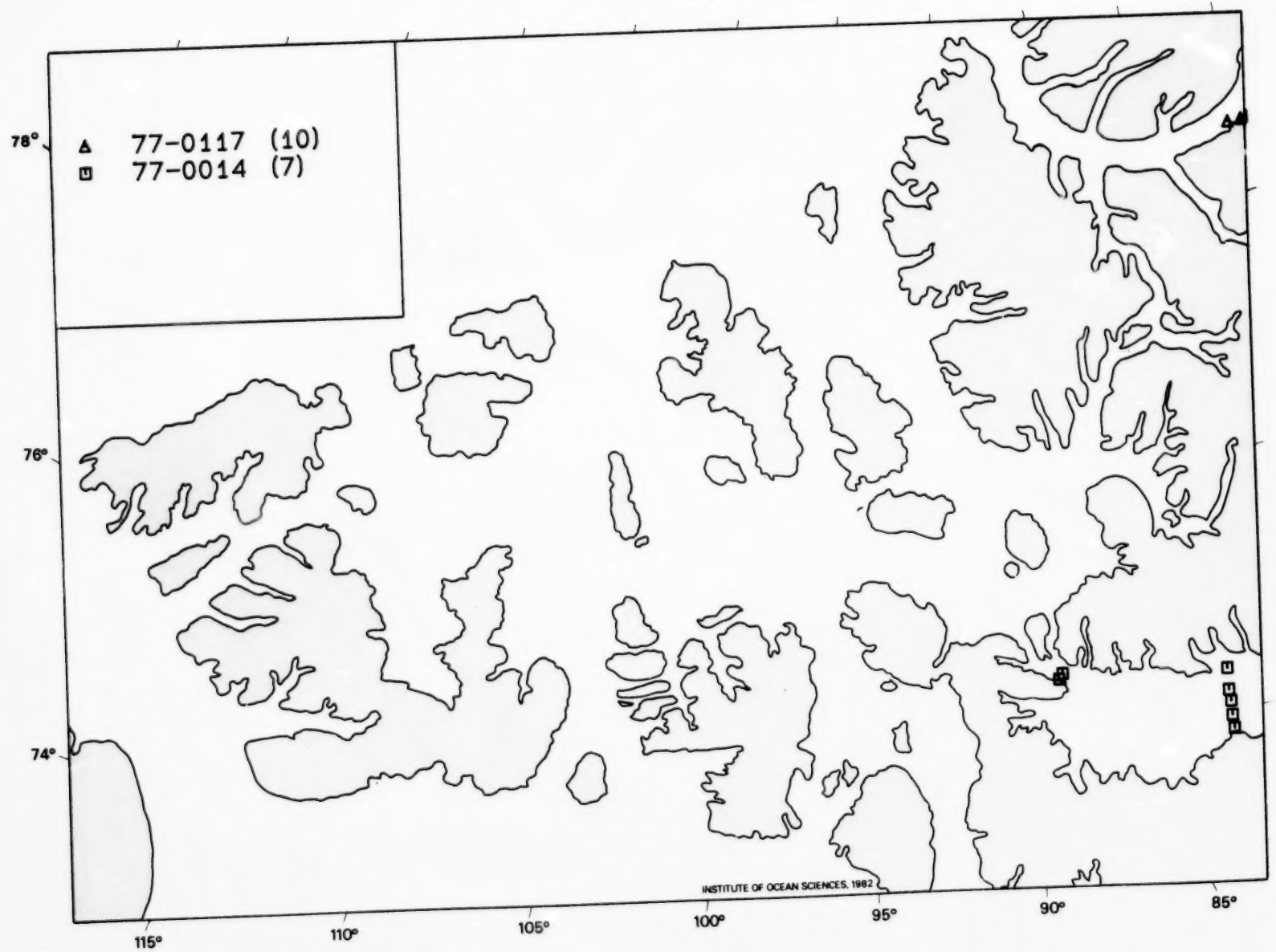
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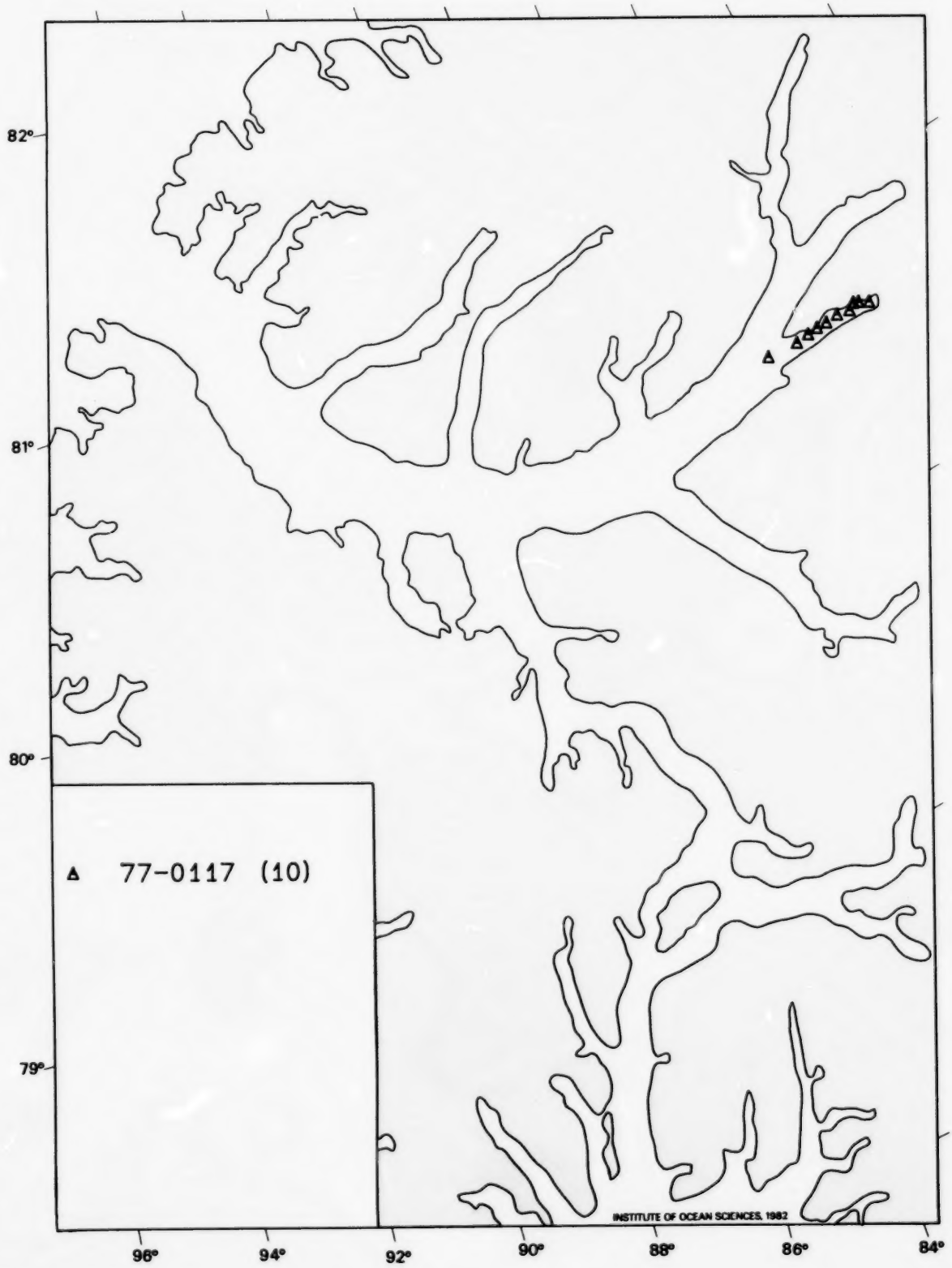
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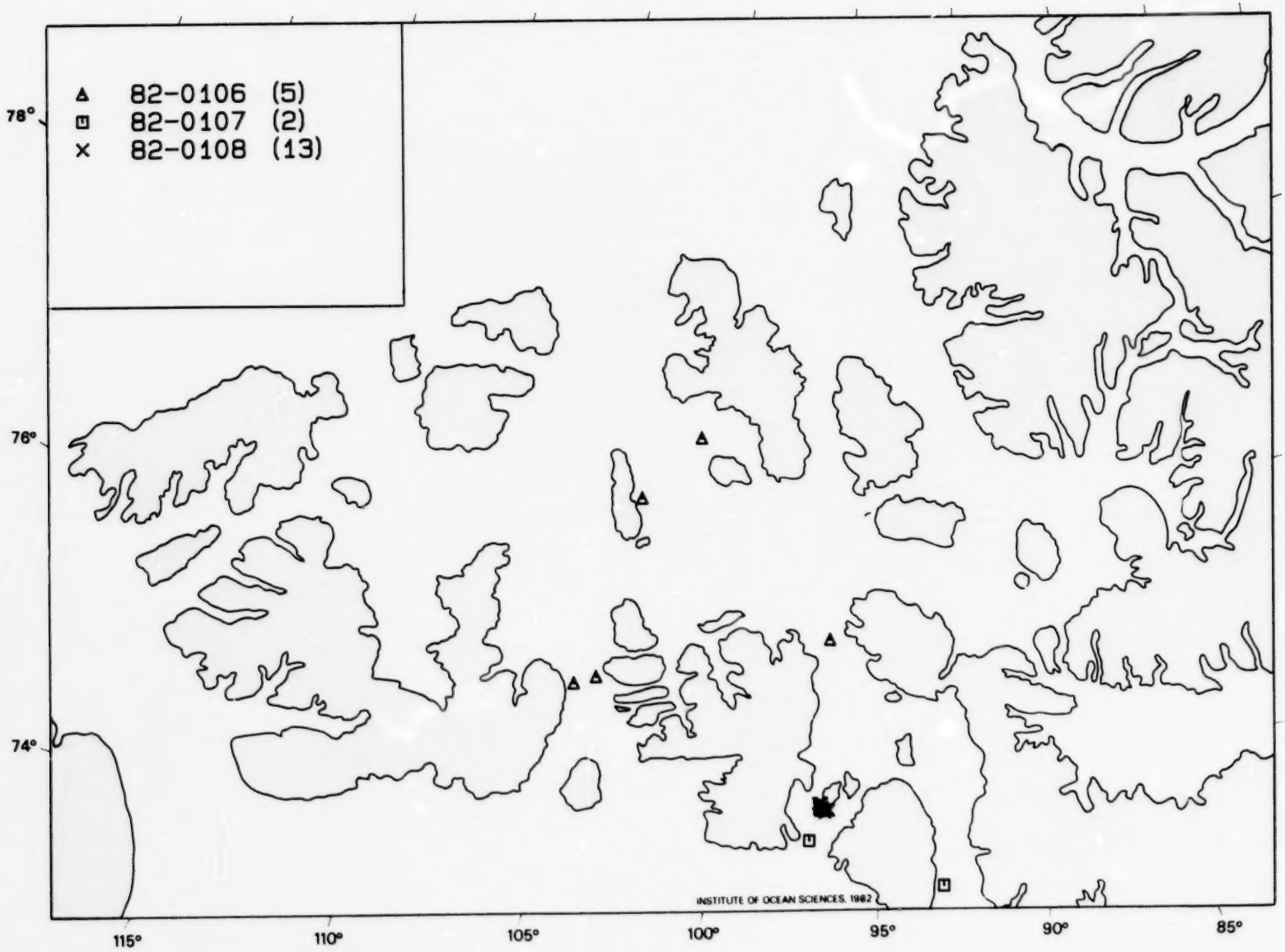
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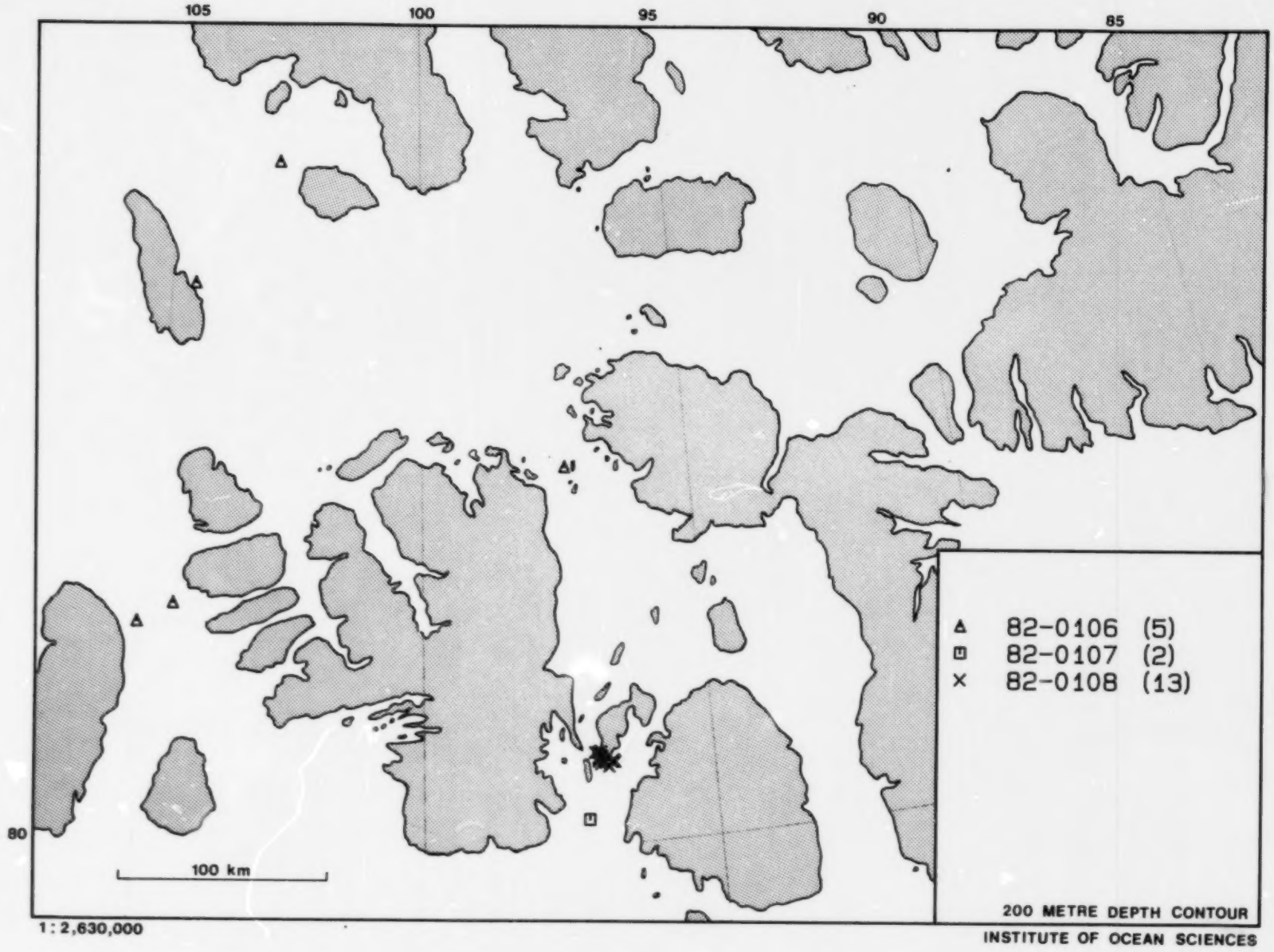
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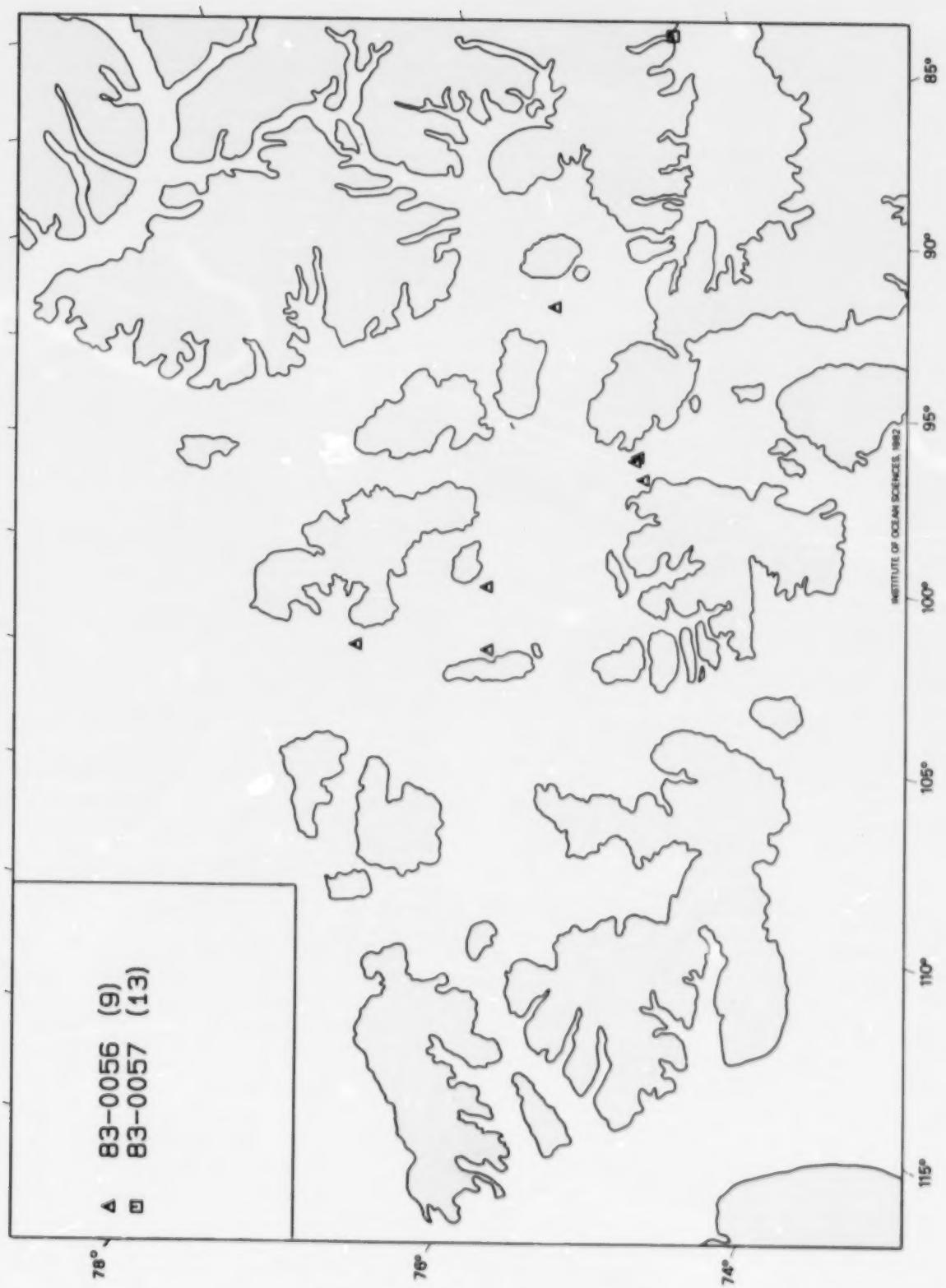
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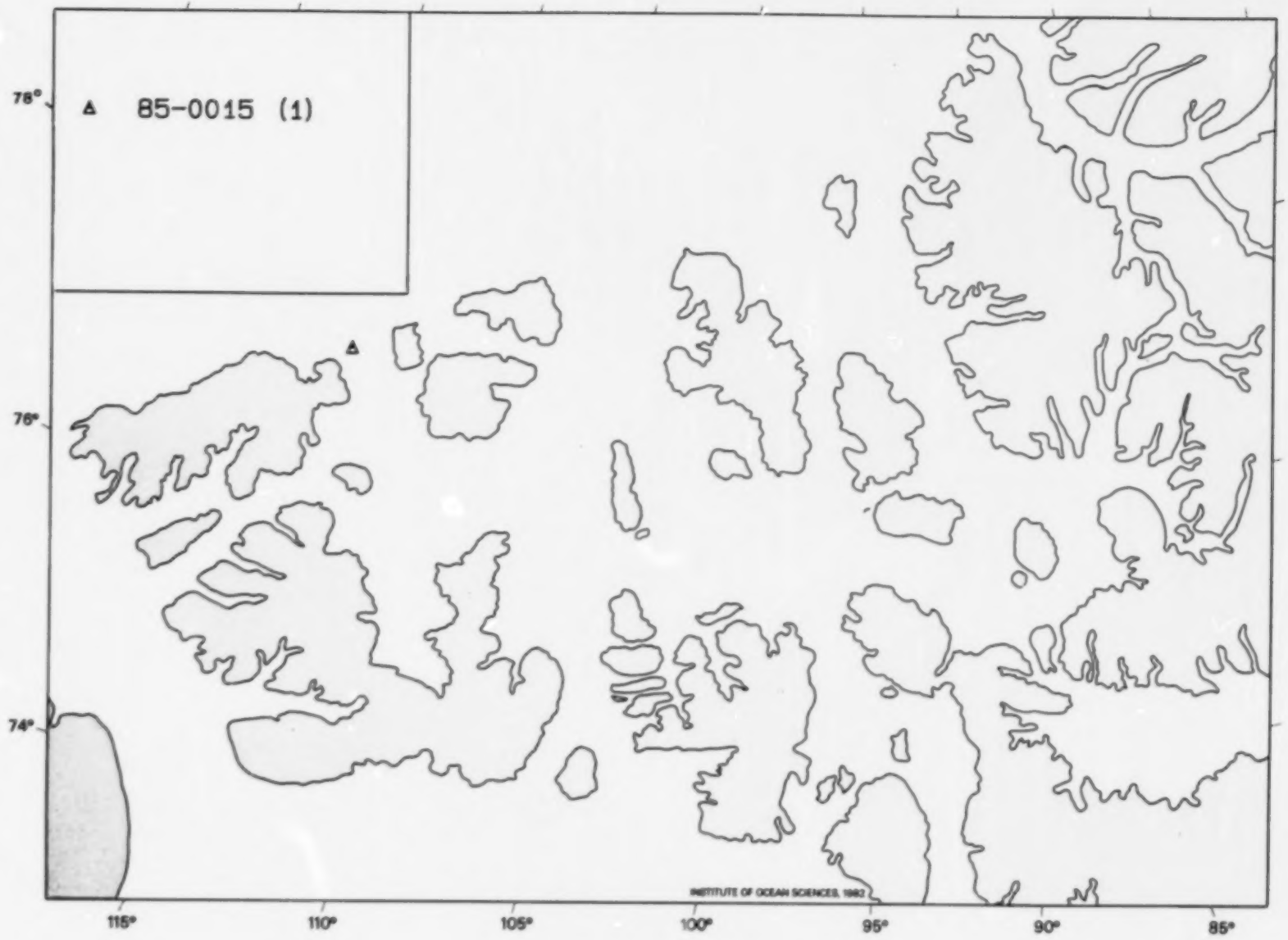
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12. INDICES

12.1 Alphabetical Listing of Data Set Occurrence by Geographic Area

AUSTIN CHANNEL	BALLANTYNE STRAIT	BYAM MARTIN CHANNEL	CROZIER STRAIT	DANISH STRAIT	EUREKA SOUND
74-0014A 74-0023 76-0010	85-0015	82-0106	74-0121 82-0108	74-0118	52-0003

FRAM SOUND	GREELY FIORD	JACKSON BAY	JONES SOUND	KELLETT STRAIT	MACLEAN STRAIT
77-0014	73-0128 75-0137 75-0038 76-0117 77-0117	74-0118	61-0078 63-0057 63-0001 71-0107 77-0014 83-0057	62-0006	82-0106 83-0056

MCDOUGALL SOUND	NANSEN SOUND	NORWEGIAN BAY	PEARY CHANNEL	PENNY STRAIT	PRINCE GUSTAF ADOLF SEA
82-0107 83-0056	62-0005 62-0006 62-0067 64-0008	62-0006 68-0001	60-0066	62-0006 82-0106	60-0066 61-0009 61-0077 64-0054

SLIDRE FJORD	STRAND FJORD	SVERDRUP CHANNEL	WELLINGTON CHANNEL
62-0005 62-0067	62-0066	62-0066	62-0006 68-0001 72-0011 82-0107

12.2 Index of References by Data Set Number

Index of References by Data Set Number
(Secondary references are indented.)

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